IDAHO DEPARMENT OF FISH AND GAME

Rod Sando, Director

FEDERAL AID IN FISH RESTORATION
1998 Job Performance Report
Project F-71-R-23

REGIONAL FISHERIES MANAGEMENT INVESTIGATIONS
PANHANDLE REGION (Subprojects I-A, II-A, III-A, IV-A)

SUBPROJECT I.	SURVEYS AND INVENTORIES
Job a.	Panhandle Region Mountain Lakes Investigations
Job b.	Panhandle Region Lowland Lakes Investigations
Job c.	Panhandle Region Rivers and Streams Investigations
SUBPROJECT II.	TECHNICAL GUIDANCE
SUBPROJECT III.	HABITAT MANAGEMENT
SUBPROJECT IV.	POPULATION MANAGEMENT

By

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May 2002
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1998 ANNUAL PERFORMANCE REPORT

State of: Idaho   Program: Fisheries Management F-71-R-23

Project: I-Surveys and Inventories   Subproject: I-A Panhandle Region

Job No.: a   Title: Mountain Lakes Investigations

Contract Period: July 1, 1998 to June 30, 1999

ABSTRACT

We conducted mountain lake surveys on Sand and Dennick lakes to assess the current status of the fisheries and evaluate current stocking rates. We used gill nets and angling to evaluate size structure, abundance, and growth of stocked fish. We also estimated the general level of human use the lakes received. Sand Lake appeared to receive light angling pressure and was characterized by moderate growth rates and a quality size-structure. Fish ranged from 220 to 438 mm in length, and from one to four years in age. Because of the low angler use and only average growth rates, a reduction from annual stocking to alternate year stocking is recommended.

Dennick Lake appeared to have a relatively low abundance of fish, and was particularly lacking in quality sized fish. We caught only four cutthroat trout *Oncorhynchus clarki*, which ranged in length from 162 to 285 mm, and were from one to three years old. Growth was slow in comparison to Sand Lake and other lake populations. We caught one brown trout *Salmo trutta*, which was 335 mm. This fish was either a slow-growing survivor from a group of 150 brown trout mistakenly stocked in Dennick Lake in 1992, or it was naturally produced from adults of the 1992 stocking. Our survey indicated cutthroat trout were not abundant and had slow growth and low relative weights. The low abundance may be the result of excessive brown trout predation on stocked cutthroat fry.

We surveyed Porcupine Lake to assess species composition. We evaluated the feasibility of eradicating brook trout *Salvelinus fontinalis* in Porcupine Lake with the use of piscicides to benefit the downstream bull trout *S. confluentus* population. The survey of Porcupine Lake supported our belief that bull trout are not present in Porcupine Lake and are restricted to the portion of Porcupine Creek below the high gradient reach near the lake outlet. Brook trout are abundant and reproducing naturally in Porcupine Lake. Although chemical renovation could be used to eradicate brook trout from Porcupine Lake and the upper reaches of Porcupine Creek, such an effort would be difficult and precarious because of the volume of discharge from the lake and the proximity of bull trout in Porcupine Creek.

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OBJECTIVES

1. Evaluate stocking rate and stocking frequency of mountain lakes in relation to observed angler use, catch rates, growth rates, and fish abundance as determined by angling and gillnetting.

2. Establish limnological and water chemistry baselines to determine potential productivity and to determine future changes.

3. Provide diverse angling opportunities by maintaining a stocking program with different species of salmonids in Panhandle Region mountain lakes.

4. Assess the species composition of Porcupine Lake and evaluate the feasibility of eradicating the brook trout *Salvelinus fontinalis* population.

INTRODUCTION

Approximately 63 mountain lakes are stocked with fish in the Panhandle Region. Species stocked include westslope cutthroat trout *Oncorhynchus clarki lewisi*, domestic Kamloops rainbow trout *O. mykiss*, golden trout *O. aguabonita* and grayling *Thymallus arcticus*. The majority are stocked as fry at a density of around 600 fish/ha. Most lakes are stocked on alternate years, although the heavily used, highly accessible lakes are stocked each year. Most lakes are stocked by Idaho Department of Fish and Game (Department) volunteers by backpack or horsepack. In addition, a few lakes with motorized vehicle access receive extensive fishing pressure and are, therefore, stocked each year with catchable rainbow trout. Mountain lake surveys are conducted by Department personnel with the primary objective of assessing the quality of the mountain lake fishery and evaluating the current stocking schedule.

In contrast to the typical mountain lake surveys, our 1998 survey of Porcupine Lake was to evaluate the feasibility of eradicating the self-sustaining brook trout population. A reproducing brook trout population exists in Porcupine Lake and the upper portion of Porcupine Creek. This population is considered a potential threat to the native bull trout *S.confluentus* population through hybridization (Leary et al. 1993; Mullan et al. 1992) and competition and/or predation (Dambacher et al. 1992; Ratliff 1992). Porcupine Creek, which originates in Porcupine Lake and flows into Lightning Creek, has historically been an important spawning and rearing stream for adfluvial (Pend Oreille Lake) bull trout. As many as 52 bull trout redds were counted in Porcupine Creek in the 1980s. Although few or no redds have been counted annually since 1992, a juvenile bull trout population assessment in 1997 indicated relatively high numbers of juvenile bull trout. This suggests it is still important bull trout habitat. A 1997 electrofishing effort indicated that while juvenile bull trout dominated the lower portion of Porcupine Creek, the upper portion (upstream from a high gradient reach) was dominated by brook trout. Successful eradication or reduction of the brook trout population likely depends on targeting brook trout in both Porcupine Lake and Porcupine Creek. Prior to any eradication efforts, we needed to confirm that no bull trout exist in the lake or in Porcupine Creek above the high gradient reach.

METHODS

Mountain lake fishery assessment surveys entail sampling and/or documenting presence of fish and other aquatic biota, limnological sampling, and a recreational use survey. We collected fish samples with floating and sinking experimental gill net sets and conventional angling methods. Scales were collected for age analysis, and stomach contents were examined for diet analysis. We also recorded information pertaining to the presence of amphibians and aquatic invertebrates. Physical characteristics surveyed included the type of lake, aspect, depth profile, and inlet/outlet documentation. Chemical characteristics surveyed included alkalinity, conductance, transparency, pH, and temperature. The recreational use survey included the quality and usage level of access and camping facilities, and a creel survey of anglers present (including our own angling efforts) to assess catch rates, species composition, and size of angled fish. We collected limnological information from Sand and Dennick lakes on July 8 and returned with gill nets to collect fish samples on August 24-25.

We surveyed Porcupine Lake on August 5-6, 1998. We used gill nets and conventional angling equipment to assess fish populations. We initially set nets for one hour to insure that any bull trout caught were not accidentally killed in the effort. We then used overnight sets of one sinking and one floating gill net to assess fish abundance and size structure. We evaluated the feasibility of using chemical treatment to eradicate the brook trout population by consulting with Department and California Department of Fish and Game (CDFG) personnel who have had extensive mountain lake renovation experience. We also evaluated the potential for establishing detoxification sites in Porcupine Creek near the high gradient reach.

RESULTS AND DISCUSSION

Sand Lake

Lake Description

Sand Lake is an approximately 2 ha lake located on the Boundary County-Bonner County line about 3 km east of Elmira in the Elmira topographic quadrangle. Sand Lake receives relatively little angling pressure or other human use. Access from the road to the lake is poor, with an undeveloped, poorly marked trail of about 1.5 km in distance and only a partial, undeveloped trail around the lake. There is one campsite and fire ring and a minimal amount of litter in the area.

At an elevation of 976 m, Sand Lake is one of the lowest mountain lakes in the region. The lake is a shallow, eutrophic to meso-eutrophic system with maximum depth of around 5 m and a broad littoral zone of emergent and floating macrophytes. Secchi disc transparency was 4 m, specific conductance was 42 umHOS (@ 25^{o}C), alkalinity was 40 mg/L, and pH was 7. The lake was not strongly stratified, even in late August. A temperature/dissolved oxygen (DO) profile indicated DO levels gradually decreased from 6 mg/L at the surface to 1 mg/L at the bottom. Even in late August, however, water temperature was less than 19^{o}C throughout the water column. Sand Lake is characterized by a moderately steep shoreline of timber and dense brush. There is a seasonal outflow to Sand Creek, a Pack River tributary.

Fishery Characteristics

Minimal suitable quality spawning habitat is available in the Sand Lake inlet and outlet. Consequently, fish density is dependent almost entirely on stocking rates. In recent years, annual stocking density of Sand Lake has been maintained at about 600 cutthroat trout/hectare.

Angling and gillnetting resulted in a catch of 16 cutthroat trout from Sand Lake. Fish ranged from 220 to 438 mm in length and from one to four years in age (Figure 1). Based on back-calculated length-at-age, cutthroat trout achieve 305 mm at age-3, and growth is comparable with cutthroat trout populations from other western lakes (Carlander 1969; Figure 2). Growth was rapid when compared to oligotrophic systems such as Priest Lake but slow when compared with Henrys Lake. Relative weight ranged from 77 to 112 with a mean of 100, indicating average condition of the fish.

Summary and Recommendation

Annual stocking has been conducted in the Panhandle Region for more accessible mountain lakes where exploitation is expected to be relatively high. An annual rate of 600 cutthroat trout/ha is among the highest utilized in western state alpine lake management programs (Derhovanisian 1997). In a system with low exploitation, these densities might compromise growth rates. The low angler use, as evidenced by the lack of trails and litter, suggests that angler harvest is relatively low. Combined with indications that growth rates were only average, the exploitation rates suggest alternate year stocking would likely be sufficient to maintain adequate densities and may generate more rapid growth rates.

Recommendation-Reduce stocking rate in Sand Lake to 600 cutthroat trout/hectare on alternate years and follow up with a fishery survey in three to five years.

Dennick Lake

Lake Description

Dennick Lake is a 3.0 ha lake located in the Sand Creek drainage on state-owned land in Bonner County. Dennick Lake is about 0.7 km southwest of Sand Lake and about 2.5 km east of Elmira (11 km via road), also on the Elmira topographic quadrangle. Access to Dennick Lake is good, with a well-used trail both to and around the entire lake. A single site is available for camping.

Similar to Sand Lake, Dennick Lake is a relatively shallow, eutrophic system and is one of the lower elevation mountain lakes in the region. The lake has a maximum depth of around 8 m, a mean depth of 2.7 m, and a broad littoral zone of emergent and floating macrophytes. The lake has extremely clear water with a Secchi disc transparency of 8 m. Specific conductance was 45 umHOS (@ 25^{o}C), alkalinity was 60 mg/L, and pH was 7. The lake was not strongly stratified, even in late August. A temperature/dissolved oxygen (DO) profile indicated DO levels gradually decreased from 8 mg/L at the surface to 6 mg/L at the bottom. Even in late August, however, water temperature was less than 19^{o}C throughout the water column. Dennick Lake is characterized by a moderately steep shoreline of timber and dense brush. There is a seasonal outflow to Sand Creek, a Pack River tributary.

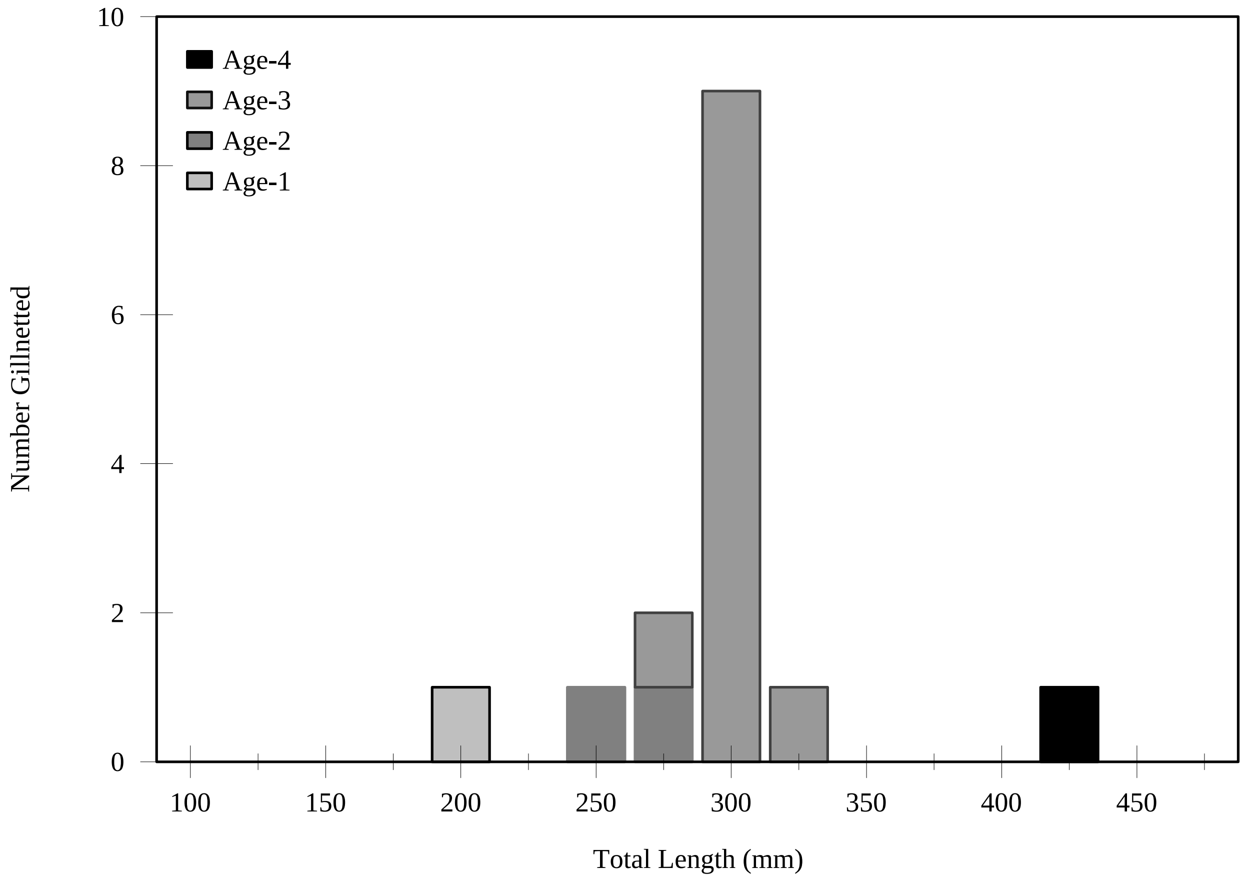

Figure 1. Length frequency and ages of cutthroat trout collected in gill nets from Sand Lake, Idaho, 1998.

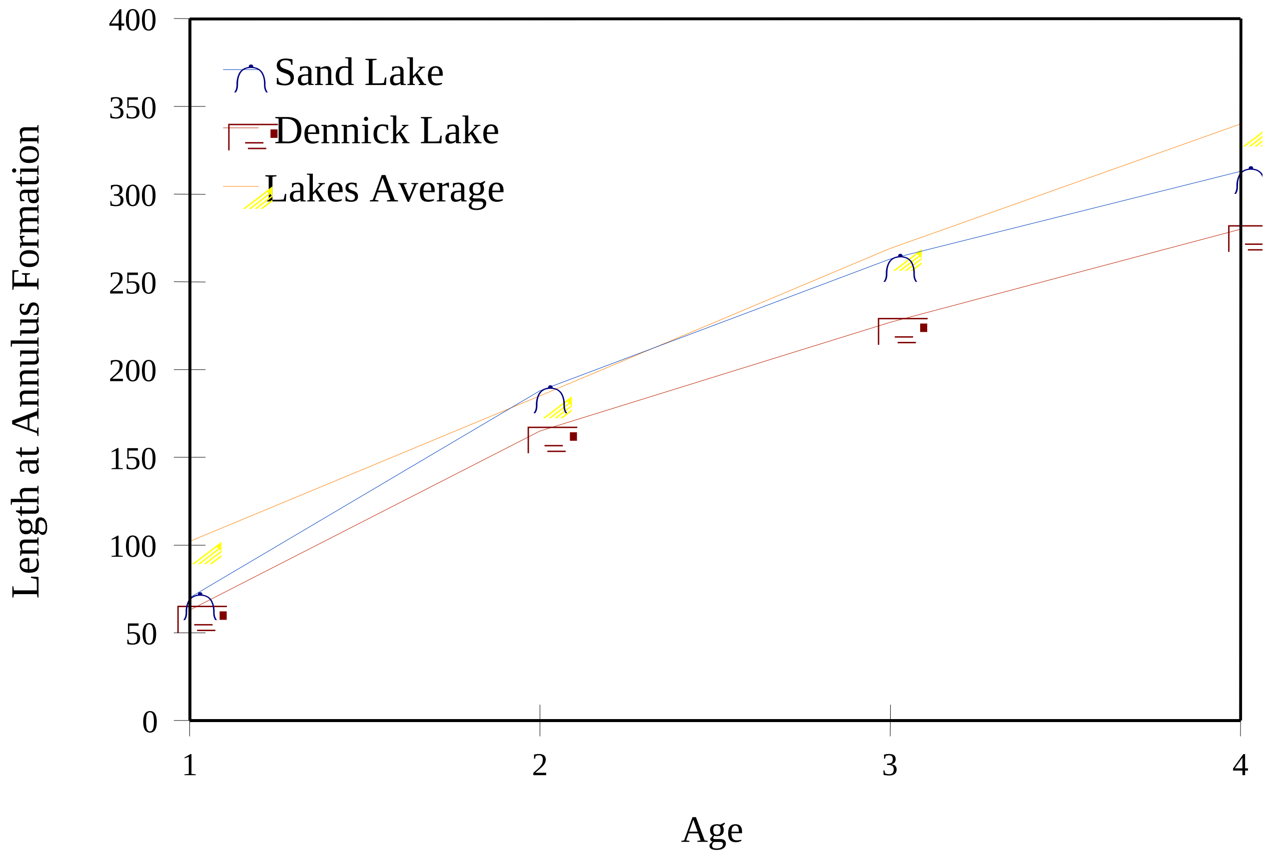

Figure 2. Back calculated length-at-age of cutthroat trout collected from Sand and Dennick lakes, Idaho, 1998, as compared with the mean of means for adfluvial trout populations in several western states (Carlander 1969).

Fishery Characteristics

Dennick Lake does not likely have significant natural reproduction. About 0.5 km of fair to poor spawning habitat is available in the inlet and outlet, and because the outlet is intermittent there is minimal rearing habitat available. Consequently, fish density is dependent almost entirely on stocking rates. In recent years, annual stocking density has been maintained at about 600 cutthroat trout/hectare.

Fish abundance in Dennick Lake was not high, as evidenced by gill net catch. An overnight set with a sinking 46 m experimental net resulted in a catch of only four cutthroat trout and one brown trout *Salmo trutta*, and no fish were caught in an overnight floating set. Cutthroat trout ranged from 162 to 285 mm, and were from one to three years old (Figure 3). Growth was slow in comparison to Sand Lake (Figure 2), and was comparable to the slowest growing populations recorded by Carlander (1969). Relative weight of cutthroat trout ranged from 80 to 93, with a mean of 87, indicating below average condition of the fish.

The single brown trout collected was 335 mm. Unfortunately, scales collected from this fish were of insufficient quality to accurately estimate age. This fish may have been a slow-growing survivor from a group of 150 brown trout mistakenly stocked in Dennick Lake in 1992. Alternatively, the limited available spawning habitat may be sufficient to provide some natural brown trout reproduction. Other aquatic species noted during the lake survey were Columbia spotted frogs of both larval and adult stages and a moderate abundance of larval and adult odonates.

Summary and Recommendation

Conflicting conclusions can be drawn from the 1998 survey results. In 1997, anglers reported a deteriorating fishery in Dennick Lake, characterized by a lack of larger (250 mm) fish. These reports are consistent with our gill net catch in the 1998 survey. The apparent lack of larger fish is not easily explained. High exploitation, winter or summer fish kills, and predation by brown trout are all plausible explanations, each of which could logically indicate that stocking larger fish or more fish might improve the fishery. Conversely, our survey indicated cutthroat trout had slow growth and low relative weights, suggesting a lack of available forage and indicating that lower stocking densities might improve the fishery.

Based on the low abundance of cutthroat trout and the persistence of brown trout six years after stocking, we believe the Dennick Lake fishery is most likely compromised by a high mortality rate of stocked cutthroat trout fry. It seems doubtful that exploitation could be high enough to prevent cutthroat trout from achieving larger sizes. On the two days that we surveyed Dennick Lake (June 30 and August 24) we saw no anglers despite fair weather. In addition, we did not see a large number of fish less than 250 mm, indicating that cropping by anglers is not a problem.

<u>Recommendation</u>-Stock fingerling cutthroat trout when possible. Follow up with a fishery survey in three to five years and evaluate the extent of natural brown trout reproduction by surveying the inlet stream in the fall.

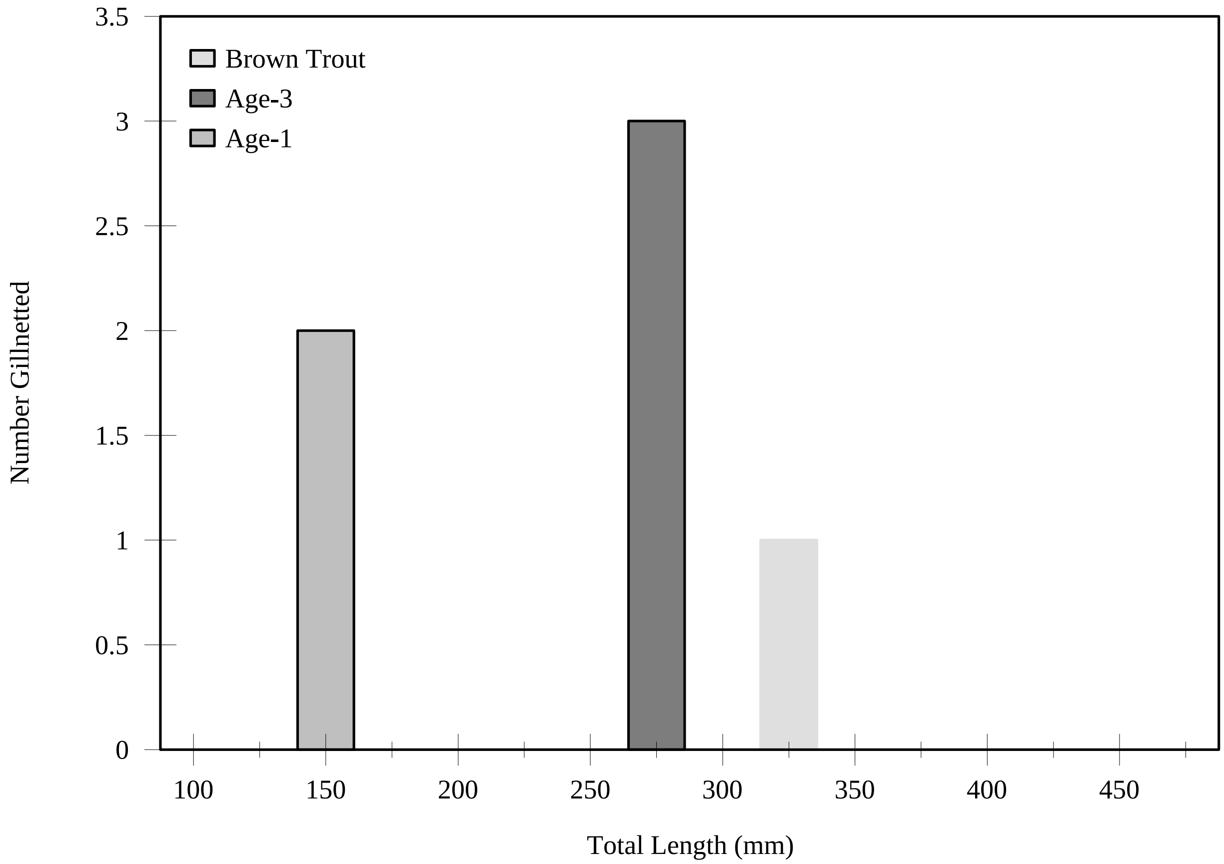

Figure 3. Length frequency and ages of cutthroat trout collected in gill nets from Dennick Lake, Idaho, 1998. Brown trout is presumably from accidental stocking in 1992 and is likely six years old.

Porcupine Lake

Lake Description

Porcupine Lake is an approximately 5 ha cirque lake in the Pend Oreille Lake drainage. The lake is located on the Clark Fork quadrangle at an elevation of 1,457 m. Porcupine Lake is accessible by vehicle by way of an approximately 5 km road from the main Lightning Creek road. The lake receives moderate to heavy angling pressure. Four developed and two undeveloped overnight campsites are available. There is a partial trail around the lake.

Porcupine Lake is stocked annually with catchable rainbow trout (except for 1987 and 1991 when the road was washed out) at a rate of 57-143 fish/ha. The lake also supports a self-sustaining brook trout population. Two small, high gradient intermittent inlets exist but provide no suitable spawning habitat except for the gravel immediately at their mouths. The outlet, Porcupine Creek, flows approximately 30 m before cascading over a series of high gradient, falls which are impassible to upstream migrating fish. The reach of stream above the falls appears to be suitable spawning habitat and likely supports much of the natural brook trout reproduction. Summertime flow of the outlet is around 1 cfs.

Porcupine Lake is a shallow, meso-eutrophic system with a maximum depth of around 4.5 m and a mean depth of 3.0 m. The shoreline is moderately steep and comprised of trees, brush, and talus. The lake supports minimal emergent macrophytes but extensive submergent bottom macrophytes. The lake has moderately clear water, with a Secchi disc transparency of 3.5 m. Specific conductance was 10 umHOS (@ 25^{o}C), alkalinity was 10 mg/L, and pH was 7.

Fishery Characteristics

As expected, we caught no bull trout in either the one-hour sets or the overnight sets in Porcupine Lake. We caught 11 brook trout and 27 rainbow trout in the gill nets. All but one rainbow trout were from 200 to 300 mm (TL) and were presumably stocked as catchables. The remaining fish was 75 mm, indicating that there is some natural rainbow trout reproduction. Brook trout ranged from 100 to 250 mm and were from 2-4 years old (Figure 4).

Summary and Recommendation

Based on consultation with experienced Department and CDFG personnel, treating the lake with rotenone or other chemical toxicants is possible but would pose a significant risk to bull trout in Porcupine Creek downstream of the lake. Detoxification would be somewhat precarious because of the size of the stream and the proximity of bull trout in the lower reaches of Porcupine Creek. Although detoxification would be possible in the several hundred meters of highly aerated cascades below the area where brook trout are established but above the area utilized by bull trout, biologists involved with mountain lake renovation projects in California are reluctant to treat any lakes with an outflow exceeding 1-2 cfs (Pat O’Brien, CDFG, personal communication).

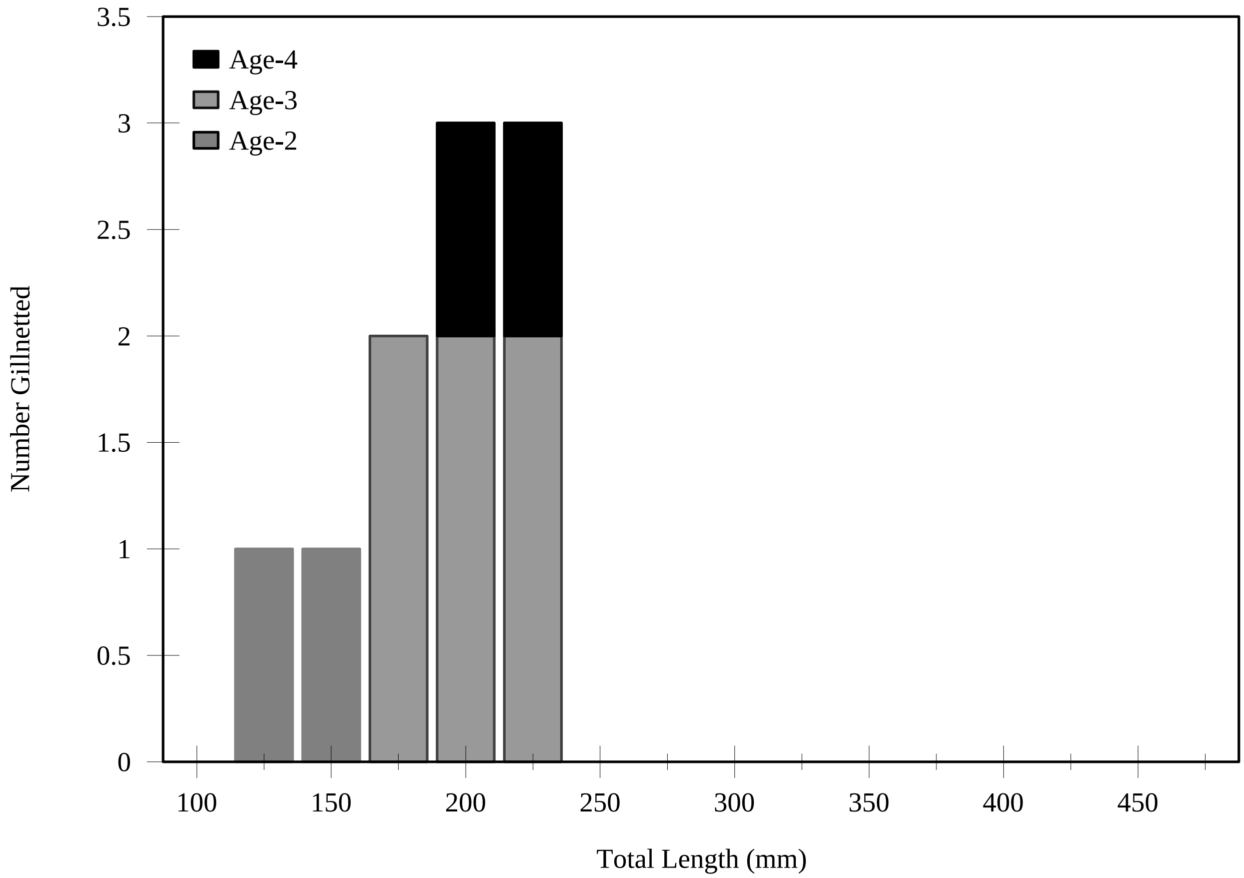

Figure 4. Length frequency and ages of brook trout collected in gill nets from Porcupine Lake, Idaho, 1998.

Other methods, such as long-term gill net sets, have the potential to reduce the brook trout population, but because of the lake's popularity with anglers, it would temporarily eliminate the lake as a fishery and would not be successful without an extensive public relations effort. Explosives have also been used to eradicate fish populations in lakes and might be an effective tool in Porcupine Lake. Explosives, combined with netting and electrofishing to remove any brook trout in the accessible portion of the outlet stream, seem to have the greatest likelihood of eliminating brook trout without threatening bull trout or sacrificing a popular fishery.

Recommendation-Use explosives to attempt brook trout eradication and follow up with a survey to evaluate effectiveness.

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1998 ANNUAL PERFORMANCE REPORT

State of:	Idaho	Program:	Fisheries Management F-71-R-23
Project:	I-Surveys and Inventories	Subproject:	I-A Panhandle Region
Job No.:	b	Title:	Lowland Lakes Investigations

Contract Period: July 1, 1998 to June 30, 1999

ABSTRACT

We used a midwater trawl to estimate the kokanee *Oncorhynchus nerka* population in Coeur d=Alene Lake in July. Age-3 kokanee density was the lowest since trawling began in 1980 at 8 fish/ha. The population of age-2 kokanee was estimated at 87,000 fish, also the lowest since 1979. The mean size of spawning kokanee was 322 mm and 340 mm for females and males, respectively, which is the largest mean spawner size since 1960. We estimated a potential egg deposition of 28.8 million eggs, the lowest since 1979.

A total of 25 chinook salmon *O. tshawytscha* redds were estimated in the Coeur d=Alene drainage in 1998. We counted 15 redds in the Coeur d=Alene River, 6 in the St. Joe River, and 4 in Wolf Lodge Creek which we did not trap in 1998 because of the low escapement. To supplement wild chinook salmon production 55,200 hatchery produced chinook salmon were stocked in Wolf Lodge Bay.

We used a midwater trawl to estimate the kokanee population in Spirit Lake in July. The age-3 population was estimated at 27,800 fish, a density of 49 fish/ha, and the age-2 kokanee population was estimated at 86,900 fish, a density of 153 fish/ha. Spreader bars increased the catch and population estimates of all age-classes, with an average increase of about one third. Nevertheless, the 1998 population estimates are below average for all age-classes. There was no significant ice fishery during the winter of 1997-1998 because of a lack of ice.

A Fisheries volunteer tagged 59 additional lake trout *Salvelinus namaycush* in Priest Lake. A total of 11 lake trout tagged in previous years were caught and reported in 1998. Growth ranged from 0 to 7 cm/year, with an average annual growth of 2.5 cm/year. Lake trout were recaptured an average of 7 km from the site of original capture.

A standardized survey of Jewel Lake indicated the quality of the trout fishery has deteriorated as a result of an overabundant yellow perch *Perca flavescens* population. Yellow perch comprised 97% of the sample biomass and had a modal size of 150 mm. Of the 25 trout collected only one was over the legal minimum size of 355 mm. Because of the extent of yellow perch in the drainage and illegal introductions, chemical renovation will not likely be effective in eradicating yellow perch.

Standardized lake surveys and a low-intensity creel survey of Cave, Medicine, and Killarney lakes indicated legal-sized largemouth bass density ranged from 2.6 to 5.3 fish/ha. Largemouth bass *Micropterus salmoides* growth was comparable to the statewide average with a mean age-at-300 mm of 4.4 years. Proportional stock densities were 44, 56, and 89 in Cave, Medicine, and Killarney lakes reflecting a large percentage of quality-size fish. Based on catch curves, total annual mortality was relatively low, ranging from 14% to 31%. Tag returns indicated exploitation throughout the Coeur d=Alene system was only around six percent. Based on tag returns, catch curves, and the creel survey, more restrictive regulations are not warranted for largemouth bass in the Coeur d=Alene Lake system.

Conservation officers collected creel survey information from 489 residents and 41 nonresidents, for a total of 530 anglers on 24 regional lakes and sloughs in 1998. In total, 694 angler hours were represented over 104 days in the lakes portion of the officer creel survey.

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OBJECTIVES

1. Determine stock status of kokanee *Oncorhynchus nerka* in Coeur d'Alene Lake.

2. Estimate chinook salmon *O. tshawytscha* harvest in Coeur d=Alene Lake during fishing derbies.

3. Count chinook salmon redds in the Coeur d=Alene and St. Joe rivers and estimate production of wild chinook salmon.

4. Determine stock status of kokanee in Spirit Lake.

5. Compare midwater trawl catches of kokanee with and without the use of spreader bars.

6. Evaluate current status of the trout species fishery in Jewel Lake and evaluate management options.

7. Evaluate status of largemouth bass *Micropterus salmoides* populations in Cave, Medicine, and Killarney lakes.

8. Estimate exploitation of largemouth bass in the Coeur d=Alene system and evaluate need for more restrictive regulations.

9. Summarize conservation officer creel survey information collected from regional lakes.

METHODS

Fish Population Characteristics

Coeur d'Alene Lake

Kokanee Population Estimate-We used a midwater trawl, as described by Bowler et al. (1979), Rieman and Myers (1990), and Rieman (1992), to estimate the kokanee population in Coeur d'Alene Lake. Twenty-two transects were trawled during the dark phase of the moon on July 20-21, 1998. Trawl transects were selected using a stratified random sample design and were in identical locations (as near as possible) to those used in previous years (Figure 1). Kokanee were measured and weighed, and scale and otoliths were collected from representative length groups for age analysis.

We used an experimental sinking gill net to estimate mean length of male and female kokanee spawners. The net was set at depths of 3-5 m near Higgins Point for one hour on December 10. Potential egg deposition (PED) was estimated as the number of female kokanee spawners (half the mature population based on midwater trawling) multiplied by the average number of eggs produced per female.

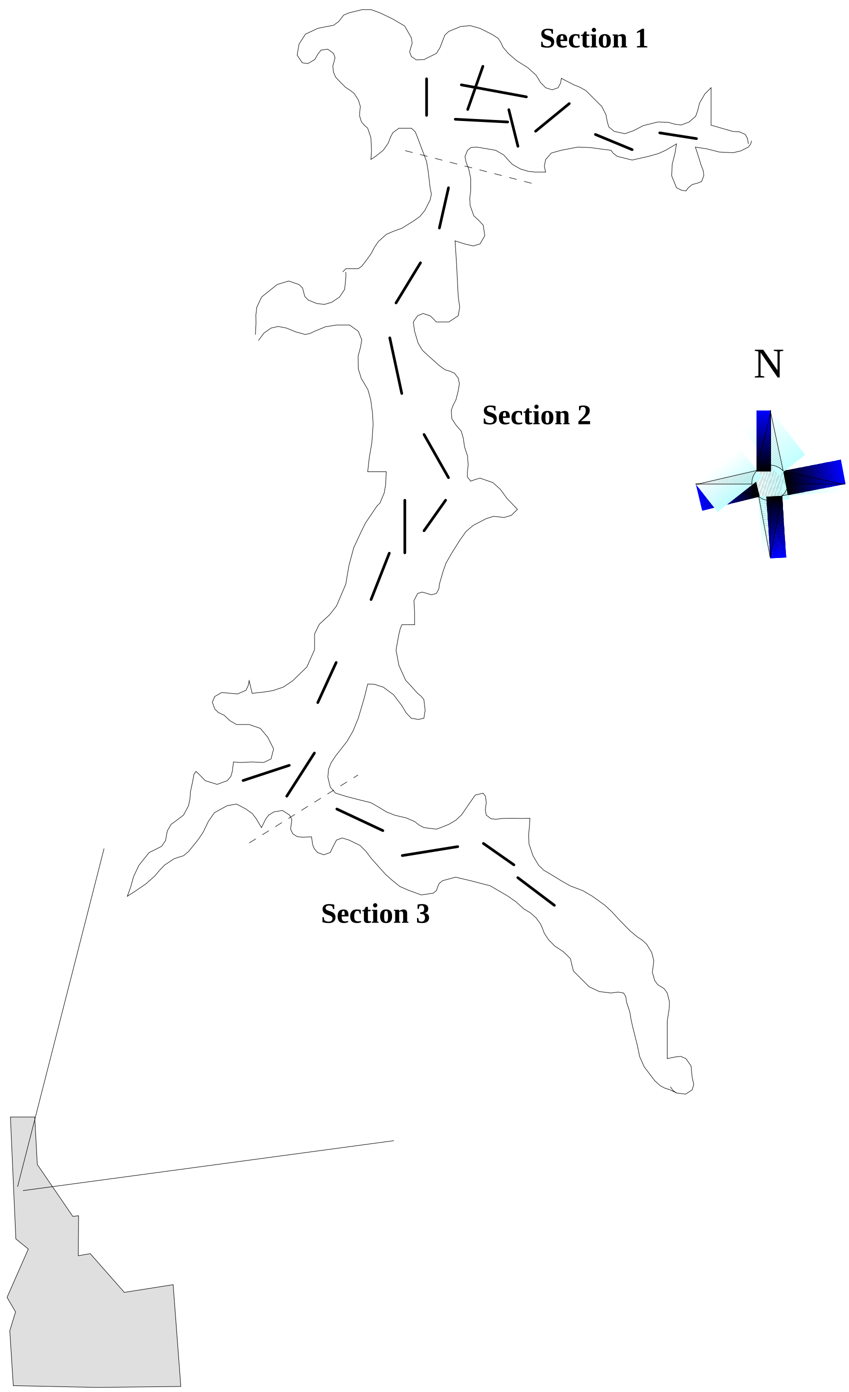


Figure 1. Location of the midwater trawling transects in three sections of Coeur d'Alene Lake, Idaho, used to estimate the kokanee population.

The average number of eggs produced per female kokanee was calculated using the following length to fecundity regression (Rieman 1992):

$$Y = 3.98x - 544$$

Where: x = mean length of female kokanee spawners (mm)
Y = mean number of eggs per female

Chinook Salmon Abundance-As in previous years, we utilized a combination of hatchery reared and naturally produced juvenile chinook salmon to maintain the chinook salmon fishery in Coeur d=Alene Lake. We estimated the natural production using redd counts, an estimate of 4,000 eggs per redd, and a mean egg-to-smolt survival of 10%. Based on these figures, we estimated that a total of 100 redds were needed to produce the target of 40,000 wild smolts. Department personnel used a helicopter to conduct chinook salmon redd surveys in the Coeur d'Alene River, North Fork Coeur d'Alene River, South Fork Coeur d'Alene River, Little North Fork Coeur d'Alene River, and St. Joe River on October 7, 1998.

Unlike previous years, we did not install a fish weir on Wolf Lodge Creek to collect eggs from migrating adult chinook salmon. We felt the trapping operation was unnecessary and impractical because of the expected low escapement, combined with the procurement of chinook salmon eggs from Priest Rapids Hatchery (Washington Department of Wildlife). Instead we conducted kelt and redd surveys to estimate natural reproduction in Wolf Lodge Creek.

We conducted creel surveys on the four chinook salmon derbies in 1998. We estimated the total number of chinook salmon caught, harvested, and released, and calculated catch rates of each derby.

Chinook Salmon-Kokanee Relationship-We used historic kokanee trawl data and chinook salmon stocking and redd count data since 1982 to evaluate the relationship between chinook salmon abundance and kokanee abundance. We used linear regression and population trend lines in an effort to determine the level of chinook salmon stocking that achieves the optimum age-2 kokanee density. Age-2 kokanee were used for the analysis because this seems to be the age that provides the most accurate estimate of a kokanee age-class. Optimum kokanee density was arbitrarily set at 60 to 125 fish/ha, based on an optimum adult (age-3) density of 30-50 fish/ha (Rieman and Maiolie 1995) and an approximate mortality of 40-50% from age-2 to age-3.

Spirit Lake

We used a midwater trawl on the night of July 22, 1998 to estimate the kokanee population and relative year-class abundance in Spirit Lake. We trawled the same five transects that have been trawled in previous years (Figure 2). After completing the five transects, we trawled the same transects again, this time with the use of spreader bars on the trawl net. Kokanee lengths and weights were recorded, and scales and otoliths were collected from representative length groups for age analysis.

We planned a creel survey for the winter of 1997-1998 to evaluate the kokanee ice fishery. Two weekdays and two weekend days were randomly selected each month for instantaneous counts and angler interviews.

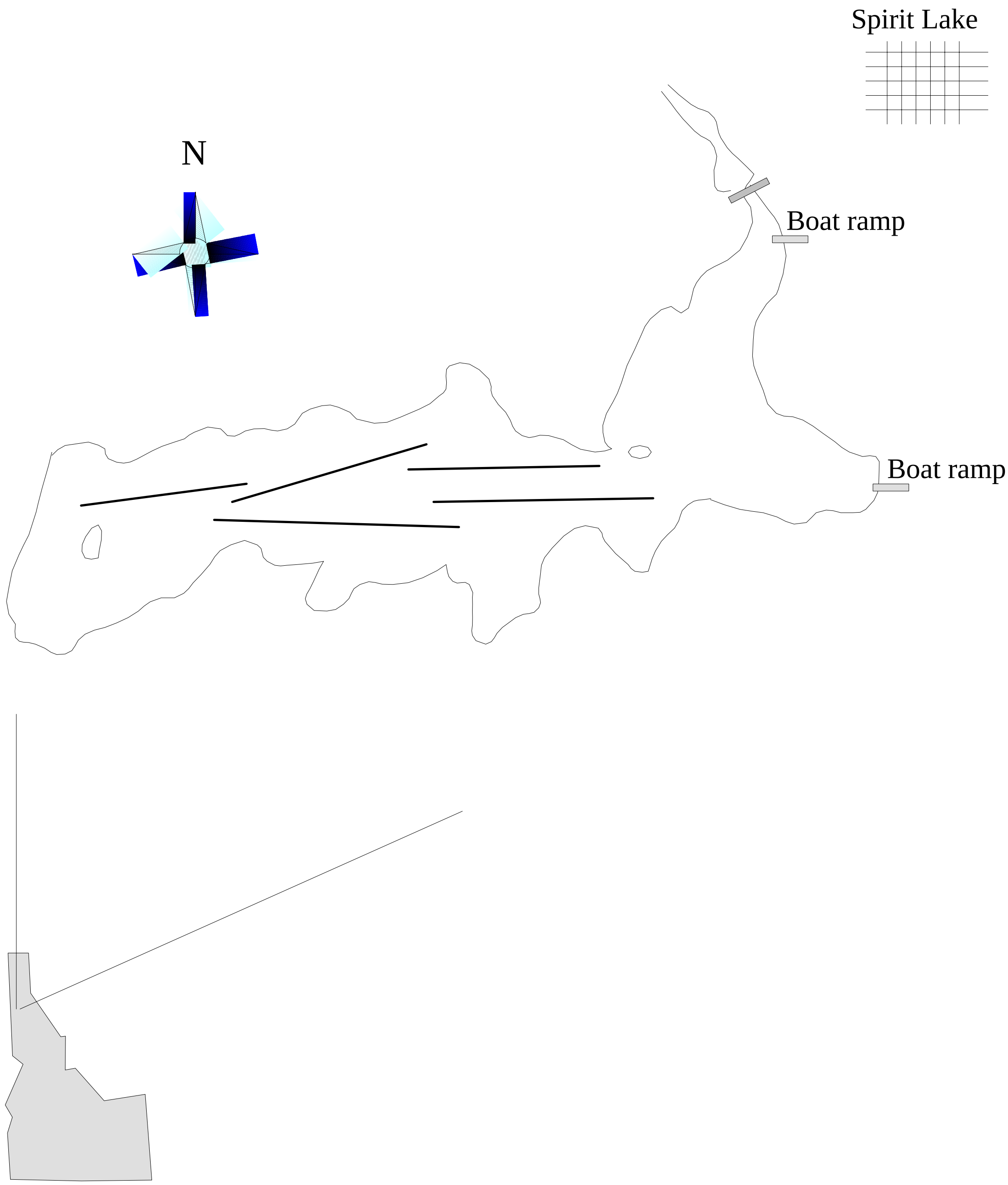


Figure 2. Location of the five midwater trawl transects used to estimate the kokanee population in Spirit Lake, Idaho.

Priest Lake

Lake trout *Salvelinus namaycush* were tagged as part of an ongoing effort to quantify angler exploitation and help define the population dynamics of lake trout in Priest Lake. All fish were caught and tagged by Randy Phelps, a volunteer angler. In 1998, we used spaghetti tags as opposed to the T-bar anchor tags that have been used in Priest Lake in recent years. Tags were placed in the dorsal musculature beneath the dorsal fin. Catch location, date, fish length and weight, and any comments regarding the health or release of the fish were recorded at the time of tagging along with the tag number. Fish were released back to the same water from which they were captured.

Some lake trout were captured at greater depths (>35 m) and did not have the opportunity to void their swim bladder before reaching the surface. These fish were assisted in their return to depth by inserting a small gauge hypodermic needle into the fishes' swim bladder at a point midway between the anal vent and pelvic fins and midway between the ventral line and the bottom of the belly. The needle was inserted at a slight angle forward until air was heard escaping and the swim bladder was sufficiently evacuated for the fish to swim down on its own. We recorded the number of all tagged fish that underwent the deflation procedure to evaluate the survival of treated fish.

Standard Lowland Lake Surveys

We conducted standard lowland lake surveys on Cave, Medicine, Killarney, and Jewel lakes using procedures outlined in the standard lowland lakes survey manual. Killarney Lake was gillnetted and trapnetted on June 8-9 and electrofished on June 23. Medicine Lake was gillnetted and trapnetted on June 9-10 and electrofished on June 24. Cave Lake was gillnetted and trapnetted on June 10-11 and electrofished on June 24.

Jewel Lake was gillnetted and trapnetted on May 21-22 and electrofished on August 20. Limnological sampling was conducted on Cave, Medicine, and Killarney lakes on July 7 and on Jewel Lake on August 21.

Largemouth Bass Population Dynamics

The secondary objective of the lateral lake surveys (Cave, Medicine, and Killarney) was to evaluate largemouth bass population dynamics in the Coeur d=Alene drainage. In addition to the standard lowland lake survey procedures, we used electrofishing to conduct mark-recapture estimates on largemouth bass in Cave, Medicine, and Killarney lakes. Marking efforts were conducted during daylight hours on April 16 (Killarney and Medicine lakes) and April 23 (Cave Lake). Recapture runs were May 5-7. We marked all legal-size fish (>305 mm) with reward tags to provide information on exploitation and timing of largemouth bass harvest. Additional fish were tagged during bass tournament weigh-ins and were redistributed to Cave, Medicine, and Killarney lakes, as well as throughout the rest of Coeur d=Alene Lake system.

We conducted a low-intensity creel survey on Cave, Medicine, and Killarney lakes to corroborate the tagging data and to provide additional information on the fisheries in these lakes. The creel survey was run from April through September, with two weekend days and two weekdays surveyed each month. Survey days and count times were randomly selected using the Department Creel Census System (McArthur 1992).

Officer Creel Survey

In an ongoing program, conservation officers recorded impromptu creel survey information collected from various regional waters. These angler contacts were not part of any structured creel survey but rather were associated with random license checks and other contacts with the fishing public.

RESULTS

Fish Population Characteristics

Coeur d'Alene Lake

Kokanee Abundance-Trawl results indicated low numbers of kokanee across all year classes in comparison with previous years (Table 1). The standing stock of kokanee in Coeur d=Alene Lake was 1.7 kg/ha. The 1996 year-class (age-2 kokanee) was estimated at 89,000 fish, which is the least abundant year-class on record. Prior to this year, the lowest year on record for age-2 kokanee was 1997, when the age-2 population was estimated at 97,000 fish compared with a previous 19-year mean of 2.1 million (95% CI= ∀544,000). The 1995 year-class (age-3) is also the lowest age-3 year-class on record. We estimated a total of 78,000 age-3 kokanee for a density of 8 fish/ha. Age-1 kokanee (1997 year-class) were also low in abundance (355,000 fish), but previous years have demonstrated the difficulty in accurately estimating abundance of age-1 kokanee. We estimated 3.625 million age-0 kokanee, which is slightly higher than the 19-year average (3.35 million). Consistent with previous years, highest age-0 kokanee densities were in the northern section of the lake (Table 2). Based on the 1997 PED estimate and the 1998 age-0 estimate, egg to fry survival was 6.67%, which is much higher than previous years (Table 3).

Kokanee fry collected in the trawl ranged from 30 to 70 mm TL. Age-1 kokanee ranged from 80 to 160 with a modal length of around 115 mm. Age-2 fish ranged from 170 to 200 mm with a modal length of around 195 mm. Size of the age-3 kokanee at the time of trawling ranged from 270 mm to 300 mm with a modal length of 285 mm (Figure 3). Typical of kokanee in Coeur d’Alene Lake, maturity was primarily at age-3. No age-2 kokanee examined were mature. One of the 16 age-3 kokanee captured was immature.

Table 1. Estimated abundance (millions) of kokanee made by midwater trawl in Coeur d'Alene Lake, Idaho, 1979-1998. To follow a particular year class of kokanee, read up one row and right one column.

Sampling	Age class					
Year	Age 0+	Age 1+	Age 2+	Age 3/4+	Total	Age 3+/ha
1998	3,625,000	355,000	87,000	78,000	4,145,000	8
1997	3,001,100	342,500	97,000	242,300	3,682,000	25
1996	4,019,563	30,278	342,369	1,414,144	5,806,354	147
1995	2,000,000	620,000	2,900,000	2,850,000	8,370,000	296
1994	5,950,000	5,400,000	4,900,000	500,000	12,600,000	52
1993	5,570,000	5,230,000	1,420,000	480,000	12,700,000	50
1992	3,020,000	810,000	510,000	980,000	5,320,000	102
1991	4,860,000	540,000	1,820,000	1,280,000	8,500,000	133
1990	3,000,000	590,000	2,480,000	1,320,000	7,390,000	137
1989	3,040,000	750,000	3,950,000	940,000	8,680,000	98
1988	3,420,000	3,060,000	2,810,000	610,000	10,900,000	63
1987	6,880,000	2,380,000	2,920,000	890,000	13,070,000	93
1986	2,170,000	2,590,000	1,830,000	720,000	7,310,000	75
1985	4,130,000	860,000	1,860,000	2,530,000	9,370,000	263
1984	700,000	1,170,000	1,890,000	800,000	4,560,000	83
1983	1,510,000	1,910,000	2,250,000	810,000	6,480,000	84
1982	4,530,000	2,360,000	1,380,000	930,000	9,200,000	97
1981	2,430,000	1,750,000	1,710,000	1,060,000	6,940,000	110
1980	1,860,000	1,680,000	1,950,000	1,060,000	6,500,000	110
1979	1,500,000	2,290,000	1,790,000	450,000	6,040,000	46
Previous mean	3,346,877	1,808,567	2,042,598	1,045,602	8,074,650	109

Table 2. Kokanee density (fish/ha) estimates for each age class in each section of Coeur d'Alene Lake, Idaho, July 20-21, 1998.

Section	Age 0	Age 1	Age 2	Age 3	Total
1	1,466	50	6	5	1,528
2	85	22	11	12	129
3	3	70	8	0	80
Whole lake	376	37	9	8	382

Table 3. Estimates of female kokanee spawning escapement, potential egg deposition, fall abundance of kokanee fry, and their subsequent survival rates in Coeur d'Alene Lake, Idaho, 1979-1998.

Year	Estimated female spawning escapement	Estimated potential number of eggs ($x10^6$)	Fry estimate the following year ($x10^6$)	Percent egg to fry survival
1998	39,000	26		
1997	90,900	54	3.60	6.67
1996	707,000	358	3.00	0.84
1995	1,425,000	446	4.02	0.90
1994	250,000	64	2.00	0.31
1993	240,000	92	5.95	6.46
1992	488,438	198	5.57	2.81
1991	631,500	167	3.03	1.81
1990	657,777	204	4.86	1.96
1989	516,845	155	3.00	1.94
1988	362,000	119	3.04	2.55
1987	377,746	126	3.42	2.71
1986	368,633	103	6.89	6.68
1985	530,631	167	2.17	1.29
1984	316,829	106	4.13	3.90
1983	441,376	99	0.70	0.71
1982	358,200	120	1.51	1.25
1981	550,000	184	4.54	2.46
1980	501,492	168	2.43	1.45
1979	256,716	86	1.86	2.20

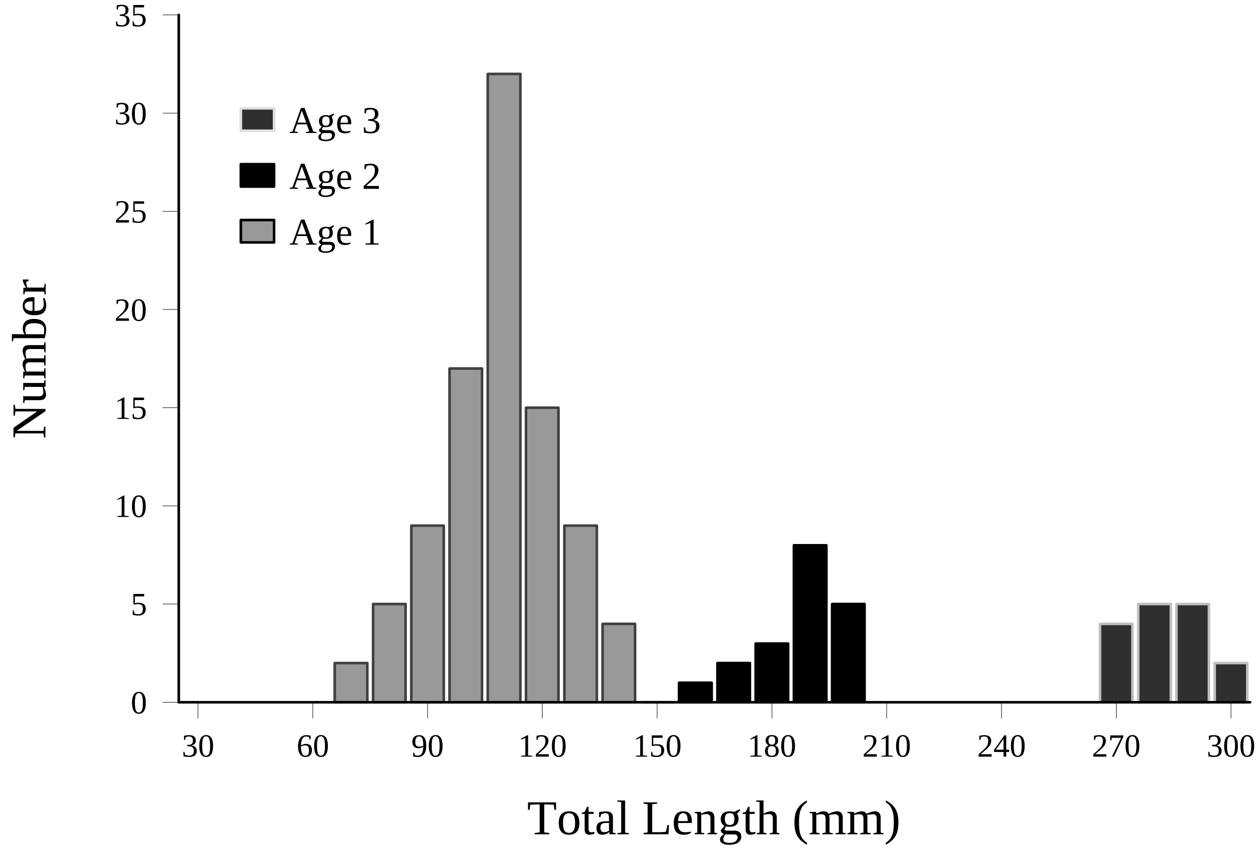


Figure 3. Length frequency and age distribution of kokanee collected by midwater trawling in Coeur d’Alene Lake, Idaho in July 1998.

In a one-hour set, we collected 420 kokanee spawners in one gill net near Higgins Point, Wolf Lodge Bay. Males far outnumbered females, with only around 5% of the sample being females. Female mean and modal lengths were 322 mm and 315 mm (TL), respectively (n=17, SD=10.0). Male mean and modal lengths were both 340 mm (n=100, SD=17.0). Mean length of spawners was the greatest it has been since 1960 (Figure 4). Mean fecundity was estimated at 738 eggs per female based on a mean female spawner length of 322 mm, and potential egg deposition was approximately 26 million eggs (Table 3). This is the lowest PED estimate to date and is well below the average for the past 18 years (142 million).

Chinook Salmon Abundance-We counted 15 chinook salmon redds in the Coeur d=Alene River drainage and four in the St. Joe River. We saw an additional four chinook salmon in the St. Joe River that were not directly on a redd. We therefore estimated the total number of redds in the St. Joe River at six. We estimated a total of four redds in Wolf Lodge Creek based on observed redds and kelts. We therefore estimated the total number of redds in the drainage at 25 (Table 4). All redds were left undisturbed to provide natural production. Conditions for counting were favorable (clear skies and clear water), and we were able to see most of the redds easily, with the exception of Wolf Lodge Creek which was largely obstructed by riparian vegetation.

We stocked 55,200 age-0 chinook salmon at the Mineral Ridge boat ramp in Wolf Lodge Bay on June 19, 1998 (Table 5). Of the total number stocked, 52,500 of these fish were from Priest Rapids hatchery and were marked with a left ventral fin clip with the assistance of volunteers from the Lake Coeur d=Alene Anglers Association. The remaining 2,700 fish were from eggs collected at the Wolf Lodge weir and were marked with a combination adipose-left ventral fin clip.

Anglers caught an estimated 549 chinook salmon during the four derbies in 1998 and harvested an estimated 196 chinook salmon (Table 6). The average catch rate was 17 h/fish, however most of the fish caught were small Ashakers≅ (less than 1 kg), and the catch rates are somewhat misleading. We did not calculate size specific catch rates but catch rate for Anon-shakers≅ was around 50 h/fish. Around 90% of the fish caught in the December derby were 400-500 mm (TL). The absence of fin-clips combined with otolith analysis indicate these are mainly age-2 wild fish (entering the lake in 1996). Based on the 1995 creel survey (Horner et al. 1997) derbies accounted for around a third of the total annual chinook salmon catch. Using this estimate, anglers caught approximately 1,663 chinook salmon in 1998 and harvested around 580.

Chinook Salmon-Kokanee Relationship-We added the 1998 data to the regression depicting the relationship between the number of chinook salmon stocked in Coeur d=Alene Lake and the estimates of kokanee population in following years (Figure 5). The abundance of age-2 kokanee was used as the dependent variable plotted against the number of age-0 chinook salmon stocked and produced naturally two years earlier (Figure 6). The additional data point supported the 1997 results, indicating around one-third of the variability in kokanee numbers is determined by chinook salmon abundance. The linear regression lines suggest that the optimal age-2 kokanee density (60 to 125 fish/ha) is associated with chinook salmon stocking levels (including natural production) of 60,000 to 80,000 fish.

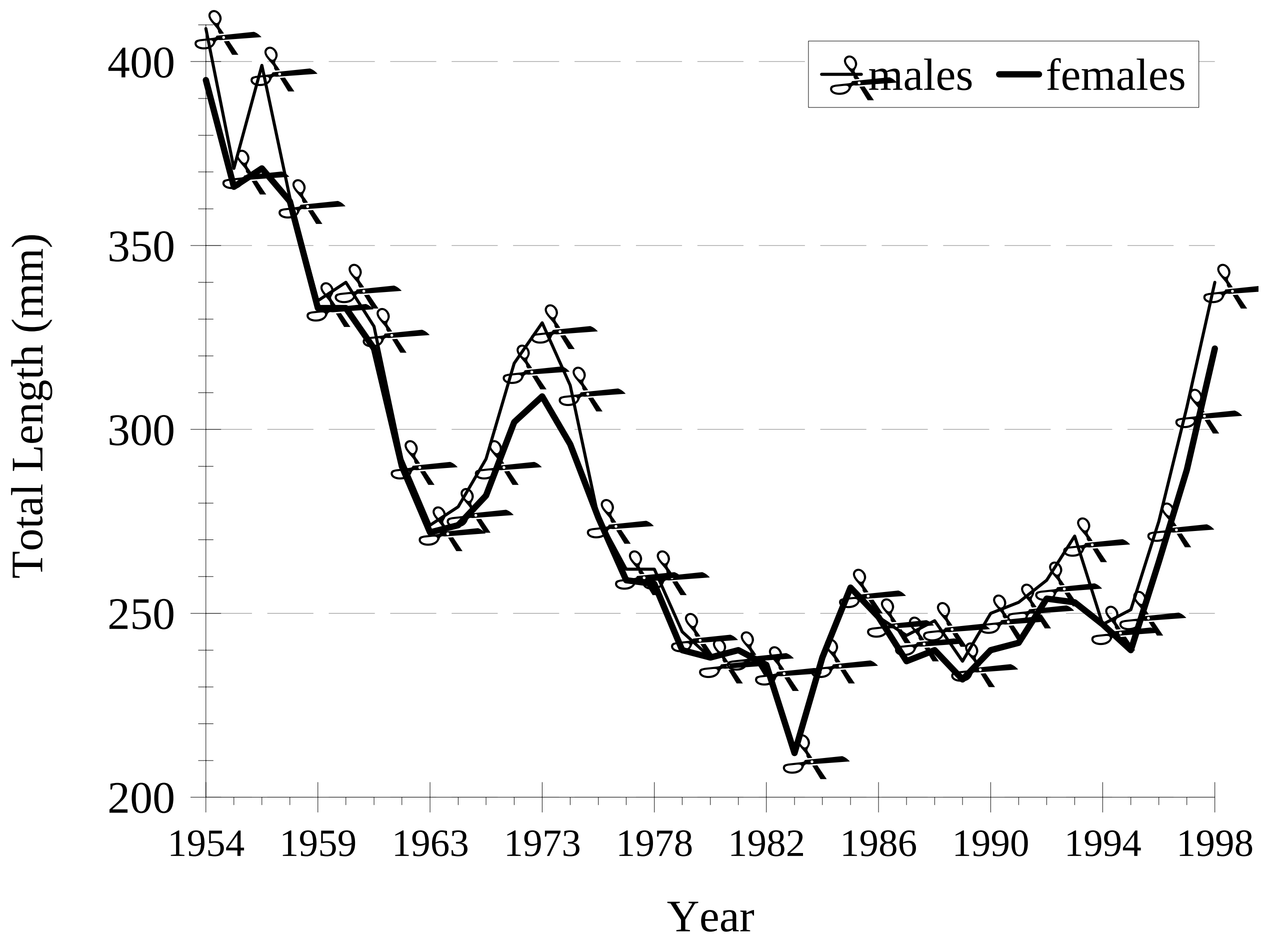


Figure 4. Mean total length of male and female kokanee spawners in Coeur d'Alene Lake from 1954 to 1998. Years where mean lengths were identical between sexes are a result of averaging male and female lengths.

Table 4. Chinook salmon redd counts in the Coeur d=Alene River drainage, St. Joe River, Lake Creek, Fighting Creek, and Wolf Lodge Creek, 1989-1998.

	Survey Date									
Location	9/29/89	11/1/90	10/31/91	10/20/92	10/18/93	10/10/94	10/04/95	10/7/96	10/7/97	10/7/98
Coeur d'Alene River										
Cataldo Mission to S.F. Cd'A River	--	41	11	29	80	82	45	54	18	11
S.F. Cd'A River to L.N.F. Cd'A River	--	10	0	5	11	14	14	13	5	3
L.N.F. Cd'A River to Steamboat Creek	--	--	2	3	6	1	1	13	6	1
Steamboat Creek to steel bridge	--	--	--	1	0	0	2	0	3	0
Steel bridge to Beaver Creek	--	--	--	--	--	0	0	0	1	0
S. F. Cd=A River	--	--	--	--	--	13	--	4	0	0
L.N.F. Cd'A River	--	--	--	--	--	0	2	0	0	0
Coeur d'Alene River Subtotal	52	51	13	38	97	110	64	84	33	15
St. Joe River										
St. Joe City to Calder	--	4	0	18	20	6	1	59	20	3
Calder to Huckleberry C.G.	--	3	1	1	4	0	0	5	2	1
Huckleberry C.G. to Marble Creek	--	3	0	2	0	1	0	7	2	0
Marble Creek to Avery	--	0	0	0	0	1	0	0	0	2
St. Joe River Subtotal	0	10	1	21	24	8	1	71	24	6
Coeur d'Alene Lake Tributaries										
Lake Creek	--	5	--	3	--	--	--	--	--	--
Fighting Creek	--	0	--	1	--	--	--	--	--	--
Wolf Lodge Creek										4
TOTAL	52	66	14	63	121	118	65	155	57	25

Table 5. Number, weight and lengths of fall chinook salmon released into Coeur d'Alene Lake, Idaho, 1982-1998.

Release date	Release site	Number released	Weight (kg)	Length (mm) Mean	Length (mm) Range	Rearing hatchery	Stock of fish	Mark
07-19-82	MR[1]	28,700	767	137	125-150	Hagerman	Bonneville	None
10-05-82	I-90	5,700	273	150	130-170	Hagerman	Bonneville	None
08-09-83	I-90	30,100	289	109	80-130	Mackay	Bonneville	None
10-26-83	I-90	30,000	637	124	80-150	Mackay	Bonneville	None
10-29-84	I-90	10,500	373	150	80-190	Mackay & Mullan	Lake Michigan	None
10-16-85	I-90	11,100	409	136	--	Mackay & Mullan	Lake Michigan	Left ventral
10-17-85	I-90	7,400	273	143	--	Mackay & Mullan	Lake Michigan	Adipose
07-02-86	I-90	29,500	375	114	81-145	Mackay	Lake Michigan	Right ventral
07-01-87	I-90	59,400	900	119	62-155	Mackay	Lake Michigan	Adipose
07-16-88	I-90	44,600	977	133	95-180	Mackay	Coeur d'Alene Lake	Left ventral
07-06-89	I-90	35,000	636	126	100-165	Mackay	Coeur d'Alene Lake	Right ventral
07-10-90	MR	35,700	626	123	80-145	Mackay	Coeur d'Alene Lake	Adipose
07-10-90	MR	650[2]	11	123	80-145	Mackay	Coeur d'Alene Lake	Ad/right vent
07-09-91	MR	41,600	750	129	75-151	Mackay	Coeur d=Alene Lake	Left ventral
07-09-91	MR	1,050[2]	16	129	75-151	Mackay	Coeur d=Alene Lake	Ad/Left vent
07-07-92	MR	10,000	500	132	115-150	Mackay	Coeur d=Alene Lake	Right ventral
1993		0			No hatchery chinook were stocked in 1993			
06-06-94	I-90	17,267	910	134	110-180	Nampa	Coeur d=Alene Lake	Adipose
06-26-95	I-90	30,198	1,050	124	90-145	Nampa	Coeur d=Alene Lake	Left ventral
06-25-96	MR	39,700	1,510	122	85-145	Nampa	Coeur d=Alene Lake	Right ventral
06-24-97	MR	12,100	227	120	69-159	Nampa	Coeur d=Alene Lake	Adipose
06-19-98	MR	52,500		97	79-111	Cabinet Gorge	Priest Rapids	Left ventral
06-19-98	MR	2,700		98	69-114	Cabinet Gorge	Coeur d=Alene Lake	Ad/Left vent

[1] MR = Mineral Ridge boat ramp.
[2] Sterile triploid fish from heat-shocked eggs.

Table 6. Summary of effort, harvest, and catch rates during the 1998 chinook salmon derbies, Coeur d=Alene Lake, Idaho.

Derby	Number of anglers interviewed	Total derby hours fished (estimated)	Estimated number of chinook salmon Caught	Harvested	Released	Catch rate (hrs/fish)[a]
April	56	1,412	20	15	5	72
June	53	1,344	21	7	14	64
August	52	4,992	262	88	175	19
December	50	1,800	246	86	160	7
Total	211	9,548	549	196	354	17

[a] Catch rates in the August and December derbies were largely a product of the large number of Ashakers≅ (chinook <20") in the catch and are not reflective of a high-quality fishery.

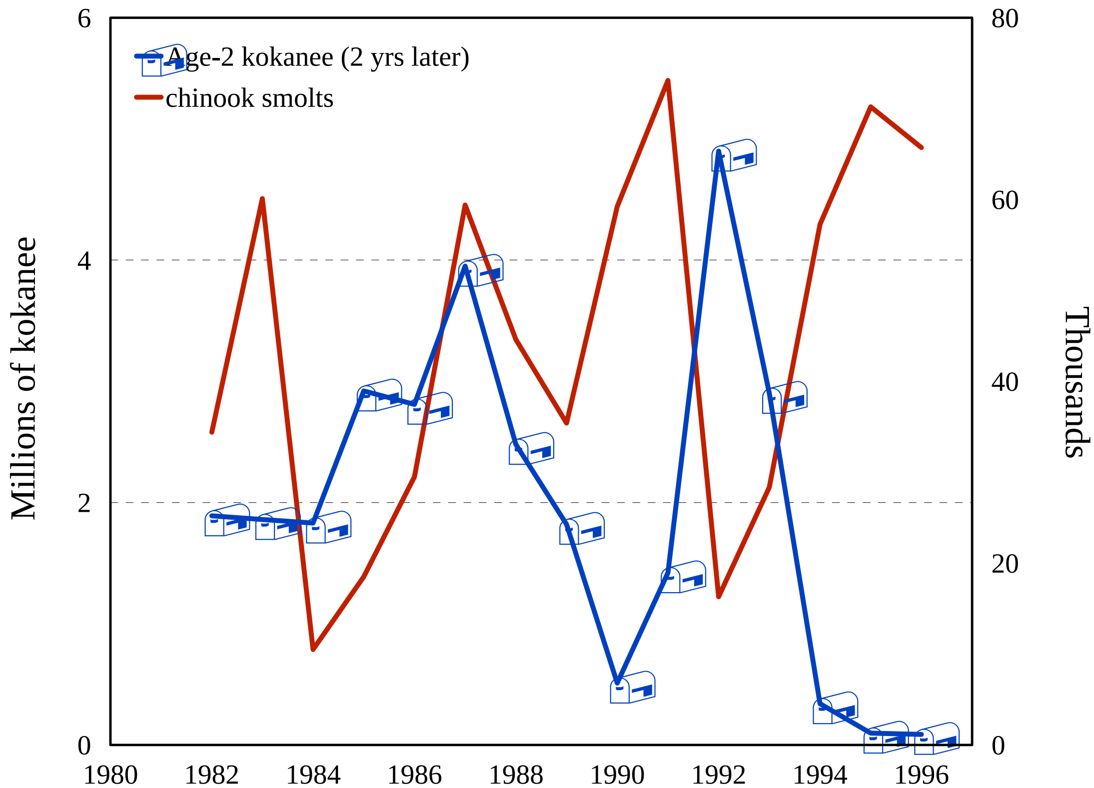


Figure 5. Estimated number of hatchery and naturally produced chinook salmon smolts entering Coeur d'Alene Lake, Idaho, since 1982, and the abundance of age-2 kokanee two years later, as estimated by midwater trawling.

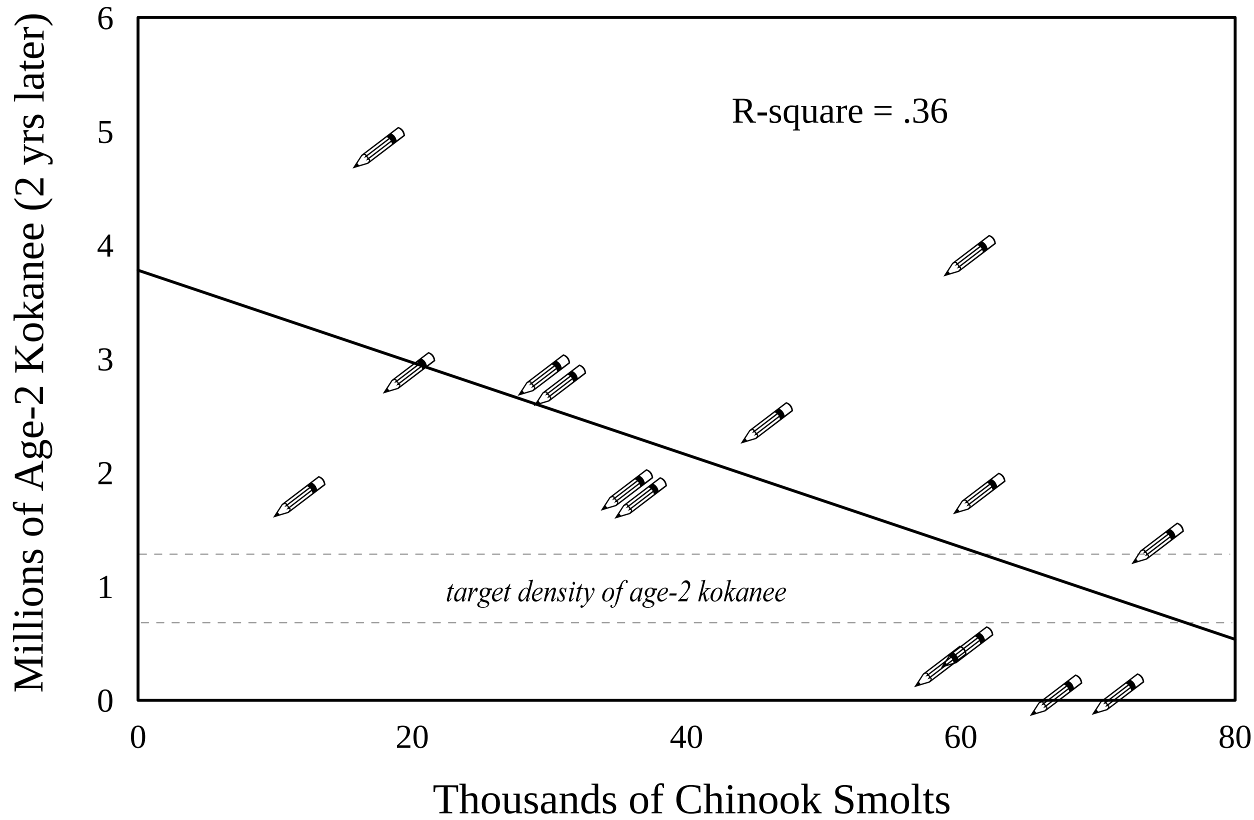


Figure 6. Linear regression model of the number of chinook salmon smolts entering Coeur d'Alene Lake, Idaho, and the abundance of age-2 kokanee two years later.

Spirit Lake

We estimated a total kokanee population in Spirit Lake of 205,214 fish, a density of 358 fish/ha (Table 7). Abundance of age-3 kokanee was estimated at 27,800 fish, or 49 fish/ha. Although this is within the target range of 30-50 fish/ha and is higher than most estimates in the 1990s, it is well below the average age-3 density since trawling began in 1981. Likewise, the age-2 kokanee were estimated at 86,900, which is higher than most recent years but lower than the average. Age-1 and age-0 kokanee populations were estimated at 62,400 and 28,100 fish, respectively, both of which are the second lowest estimates since 1981. We estimated the total biomass of kokanee in Spirit Lake at 22.5 kg/ha.

Table 7. Kokanee population estimates based on midwater trawling from 1981 through 1998 in Spirit Lake, Idaho.

	Age Class					
Year	Age-0	Age-1	Age-2	Age-3	Total	Age-3+/ha
1998	28,100	62,400	86,900	27,800	205,200	49
1997	187,300	132,200	65,600	6,500	391,600	11
1996	--	--	--	--	--	--
1995	39,800	129,400	30,500	81,400	281,100	142
1994	11,800	76,300	81,700	19,600	189,400	34
1993	52,400	244,100	114,400	11,500	422,400	20
1992	--	--	--	--	--	--
1991	458,400	215,600	90,000	26,000	790,000	45
1990	110,000	285,800	84,100	62,000	541,800	108
1989	111,900	116,400	196,000	86,000	510,400	150
1988	63,800	207,700	78,500	148,800	498,800	260
1987	42,800	164,800	332,800	71,700	612,100	125
1986	15,400	138,000	116,800	35,400	305,600	62
1985	149,600	184,900	101,000	66,600	502,100	116
1984	3,300	16,400	148,800	96,500	264,900	168
1983	111,200	224,000	111,200	39,200	485,700	68
1982	526,000	209,000	57,700	48,000	840,700	84
1981	281,300	73,400	82,100	92,600	529,400	162
Previous Mean	144,333	161,200	112,746	59,453	477,733	103

Fry	1994	1987	1985	1988	1986	1984
releases:	383,550	60,800	109,931	75,000	57,142	100,000

Spreader bars increased catch of all age-classes of kokanee. Using spreader bars, we estimated the total population to be around 32% higher than without spreader bars. Spreader bars increased the catch and population estimates of all age-classes, with the highest increase being for age-1 fish (Table 8). Nevertheless, the 1998 population estimates are below average for all age-classes even with the use of spreader bars.

Age-3 kokanee ranged from 200 to 265 mm at the time of trawling. Age-2 kokanee were bimodally distributed in length and ranged from 170 to 235 mm, overlapping with age-1 kokanee which ranged from 110 to 179 mm (Figure 7). Age-0 kokanee ranged from 30-59 mm.

There was no significant kokanee harvest from Spirit Lake during the winter of 1997-1998. Because of an unusually warm winter there was insufficient ice to support a fishery.

Priest Lake

A total of 11 tagged lake trout were reported in 1998. One of these fish had been tagged in Upper Priest Lake in 1997, and the remaining ten were tagged in Priest Lake between 1986 and 1997 (Table 9). Lake trout were caught from 0 to 15 km from their original capture site, with an average distance from original capture of approximately 3 km. Growth ranged from 0 to 7 cm/year, with an average annual growth of 2.5 cm/year.

Standard Lowland Lake Surveys

Jewel Lake

Lake Characteristics and Management-Jewel Lake is a 12 ha lake located in Bonner County, approximately 8 km west of Cocolalla Lake (Figure 8). Maximum depth is approximately 10 m. Most of the land around the lake is owned by a single landowner (Hulquist) who has allowed public access since 1951. Currently, the Department maintains the access site in exchange for public use. Jewel Lake has a single inlet stream flowing from the southwest. Two small ponds are located on private land approximately 1.5 km upstream from the lake.

Since 1990, Jewel Lake has been managed as a “quality trout” fishery: 2 fish limit; none under 14”; barbless, artificial flies and lures only; season extending from the last Saturday in April through November 30. Fishing from boats is restricted to “electric motors only.” Most fishing is from watercraft, although limited shoreline angling from the boat launch dock is possible.

Jewel Lake was renovated with rotenone in 1989 to remove yellow perch , which were illegally introduced in the late 1970s and had become over-populated and stunted. Renovation was only partially successful. Yellow perch had reestablished a population by 1992. Whether they were illegally introduced, emigrated from the pond upstream, or survived the treatment is not known.

Table 8. Comparison of kokanee catch with and without the use of spreader bars on the midwater trawl net in Spirit Lake, Idaho, 1998.

	Age-0		Age-1		Age-2		Age-3		Total	
Transect	With	W/out	With	W/out	With	W/out	With	W/out	With	W/out
1	7	2	20	13	17	20	6	8	50	43
2	0	0	20	4	17	10	8	3	45	17
3	0	1	9	13	7	18	5	10	21	42
4	8	10	9	5	10	9	3	4	30	28
5	15	11	28	19	22	13	10	4	75	47
Total	30	24	86	54	73	70	32	29	221	177

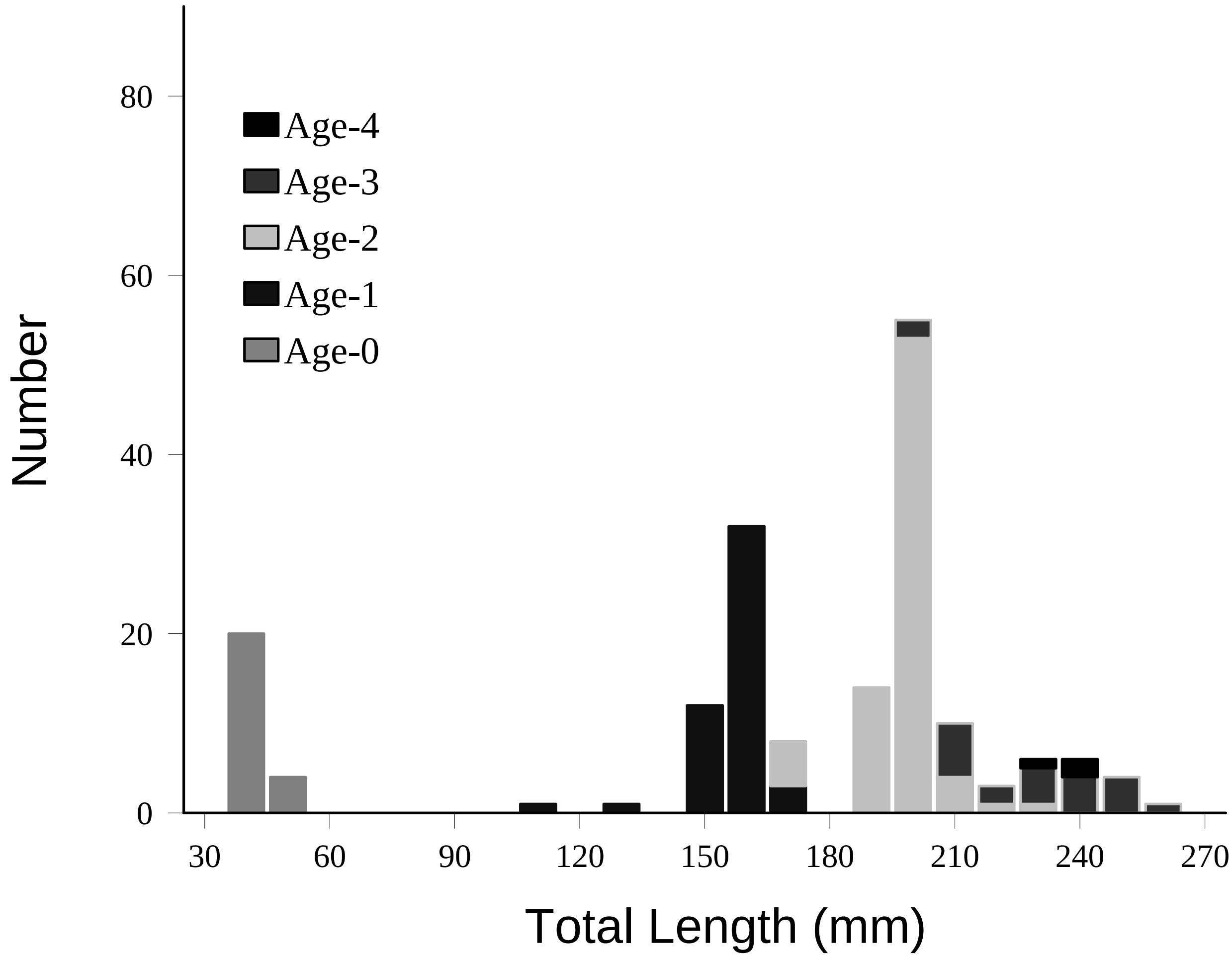


Figure 7. Length frequency and age distribution of kokanee collected by midwater trawling in Spirit Lake, Idaho in July 1998.

Table 9. Lake trout tag returns, growth, and original release site, Priest Lake, Idaho, 1998.

Tag #	Mark			Recapture			Growth (mm)		Distance (km)	Gas bladder deflation
	Date	Length	Location	Date	Length	Location	Total	Annual		
400154	7/86	660	Grn Cabin	1/98	813	Kaniksu Res.	153	13	?	
B-03546	10/86	660	4-mile I.	4/98	838	8-mile	178	15	6.5	
R1-1332	6/96	508	Bartoo I.	7/98	500	Bartoo I.	0	0	0	T
A-534	5/91	381	8-mile I.	7/98	635	Lakeview	254	36	4	
A-575	5/91	686	W. Twin I.	7/98	889	Granite Cr.	203	29	3	
R1-196	10/95	489	8-mile I.	7/98	711	Outlet Bay	222	74	11	
2904	8/97	737	Upper Pr. L.	9/98	787	Narrows	50	50	15	
A-558	5/91	686	8-mile I.	9/98	864	Narrows	178	24	5	
R1-292	8/97	508	NE Bartoo	9/98	533	Reeder Bay	25	25	6	
R1-159	10/95	406	SE Bartoo	9/98	--	Distillery B.	--	--	15	
R1-508	7/95	700	Canoe Pt.	9/98	750	--	50	17	--	

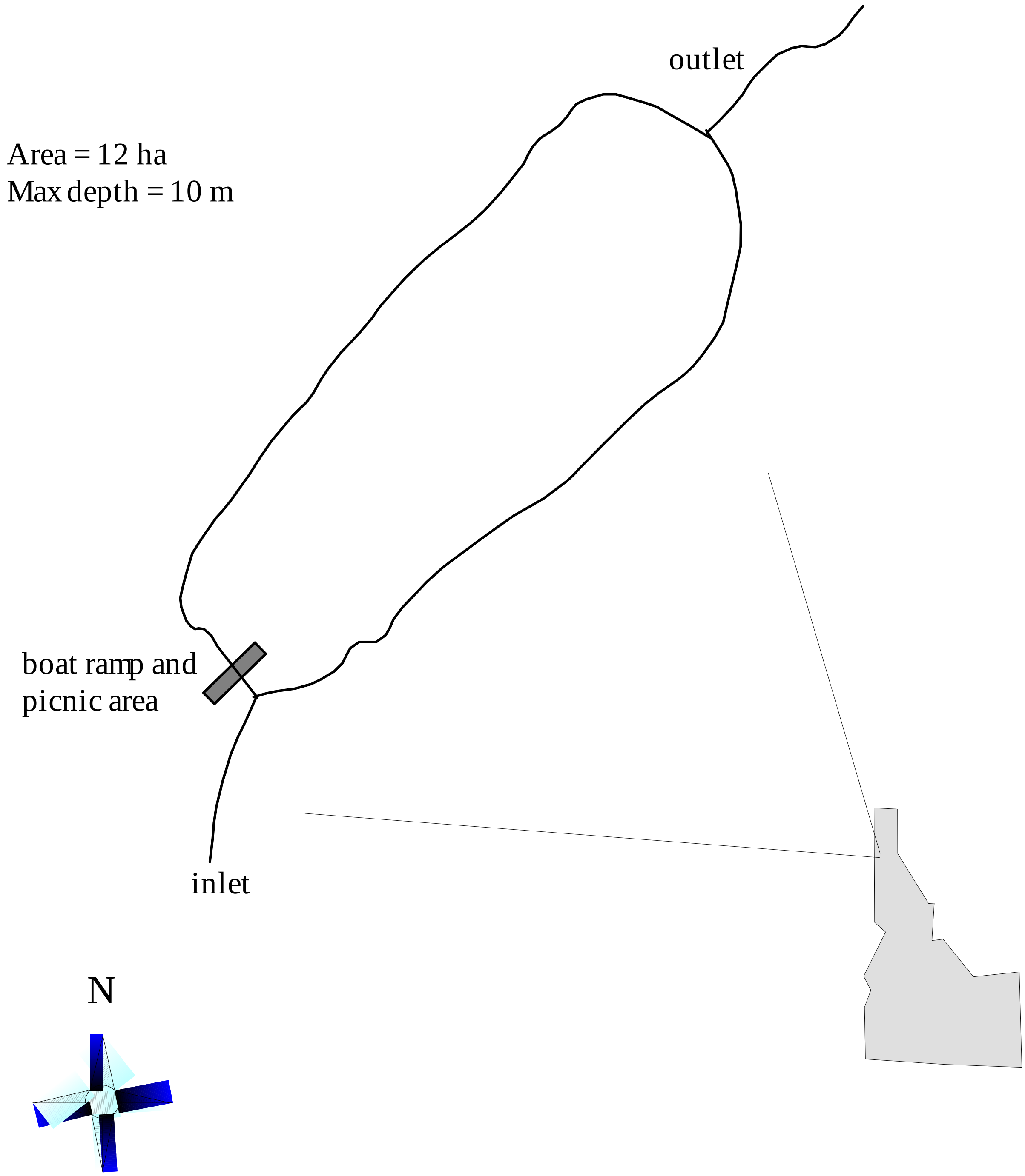


Figure 8. Location of Jewel Lake, Bonner County, Idaho.

Limnological Characteristics-Jewel Lake is a eutrophic lake, as indicated by an anoxic hypolimnion in mid-summer (Figure 9). Water clarity was moderate, with Secchi disk visibility averaging 4.1 m in August. Surface pH and conductivity were 7.5 and 26, respectively. Total alkalinity was 20 ppm at the surface and 40 ppm near the bottom.

Fishery Characteristics-Yellow perch were the dominant fish in Jewel Lake, comprising 99% of the sample by number and 97% of the sample by weight (Figure 10; Appendix A). Yellow perch were small with a modal size of 150 mm and a maximum size of 239 mm (Figure 11). Relative weight of the 150 mm fish was 85 indicating a below average condition.

Trout made up the remaining component of the sample. Cutthroat trout *O. clarki* comprised 0.4% of the sample by number and 1.4% by weight. Growth was slow, with age-5 fish averaging 245 mm. Rainbow trout *O. mykiss* (and cutthroat x rainbow hybrids) also comprised 0.4% of the sample by number and 1.4% by weight. We were not able to accurately assess growth because of the widely variable size at stocking (fry to catchables). Relative weight was less than 100 for rainbow trout. The size structure was not representative of a quality trout fishery. Of the 25 trout collected, only one was over the legal size limit of 355 mm (Figure 11).

The quality of the Jewel Lake trout fishery has deteriorated since it was surveyed in 1992 (Horner et al. 1996). At that time, yellow perch comprised only 32% of the total sample by weight and number (Table 10). We found fewer large trout in our survey (16% were over 300 mm) than in 1992 (27% were over 300 mm), and growth of trout has declined as the yellow perch population has expanded. Age-4 cutthroat trout were 310-340 mm in 1992 compared to 240-260 mm in 1998. Growth of yellow perch also seems to have deteriorated. In 1992 modal size was 220 mm, and maximum size was 310 mm compared with 150 and 240, respectively, in 1998.

Cave Lake

Lake Characteristics and Management-Cave Lake is the largest of the Coeur d=Alene River lateral lakes (Figure 12). At summer level the lake is approximately 280 hectares. The shoreline is variable with steep, rocky areas, shallow marshlands, and riprap. Approximately one-third of the shoreline is privately owned, with the remaining shoreline held by state and county roads and Union Pacific Railroad. Boat access to Cave Lake is by way of Medicine Lake, where the USFS maintains a boat launch, and a channel connects the lake to the Coeur d=Alene River. The roaded and railroaded portion of the shoreline provides good shoreline fishing access. Cave Lake is managed under general regulations for all species.

Limnological Characteristics-Water level of all the lateral lakes adjoining the Coeur d=Alene River is partially controlled by the Post Falls Dam. Winter and summer pool elevations are, therefore, consistent with Coeur d'Alene Lake which has an annual fluctuation of up to 2.1 m. At the summer elevation (648.6 m) maximum depth of Cave Lake is only around 6 m, and mean depth is around 3 m. Total dissolved solids reading was 20 mg/L, and the morphoedaphic index (MEI; TDS/mean depth) was 2. Water conductivity near the surface was 37 umHOS. Because of the size of the lake, lack of depth, and exposure to wind, Cave Lake has a deep epilimnetic layer and is not strongly stratified. Water temperature in the upper 4.5 m was 22-24^{0}C on July 7. The lower 1.5 meters was around 18^{0}C, with DO levels of 6-7 ppm (Figure 13). Secchi disk visibility averaged around 2.5 m.

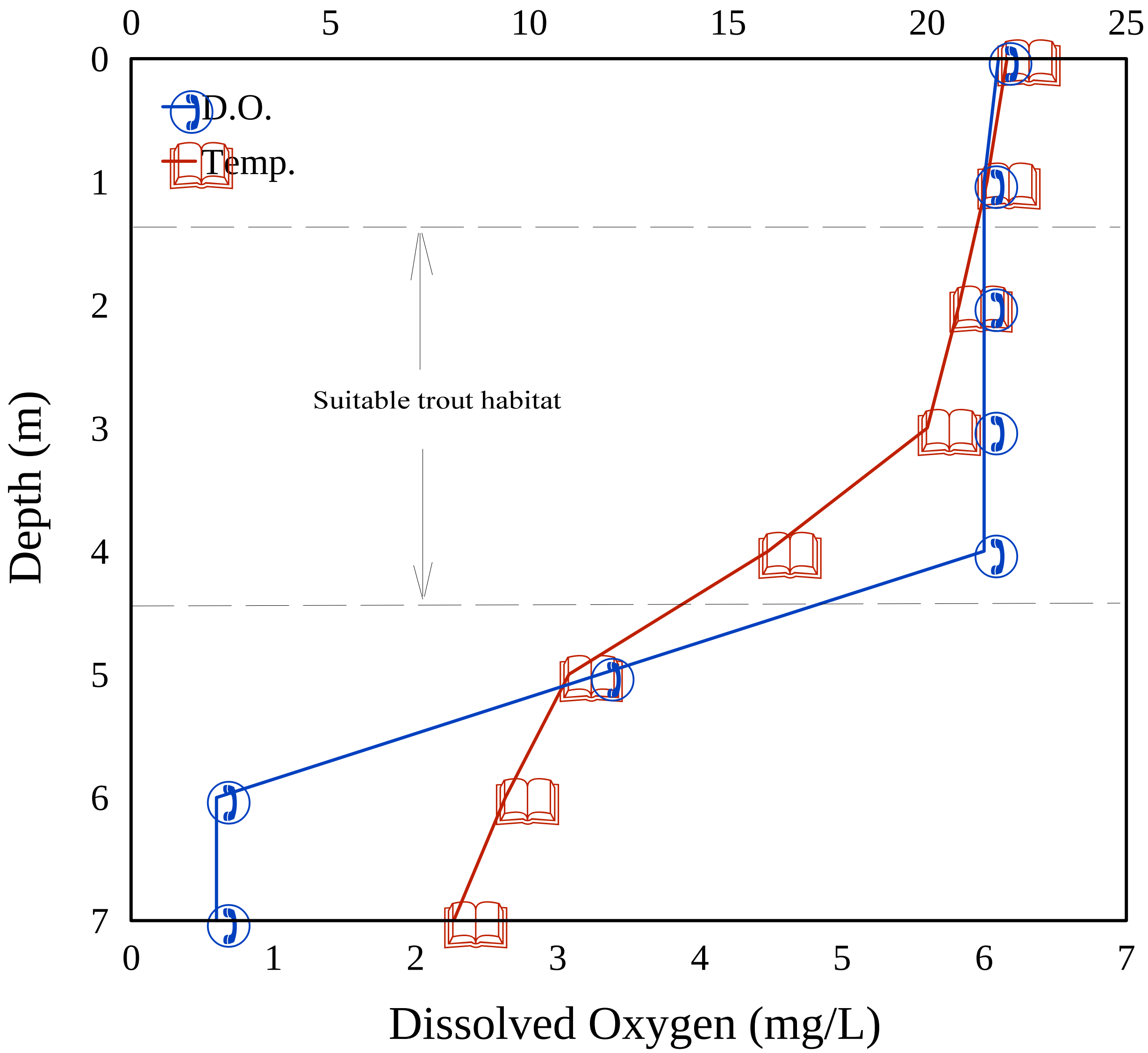
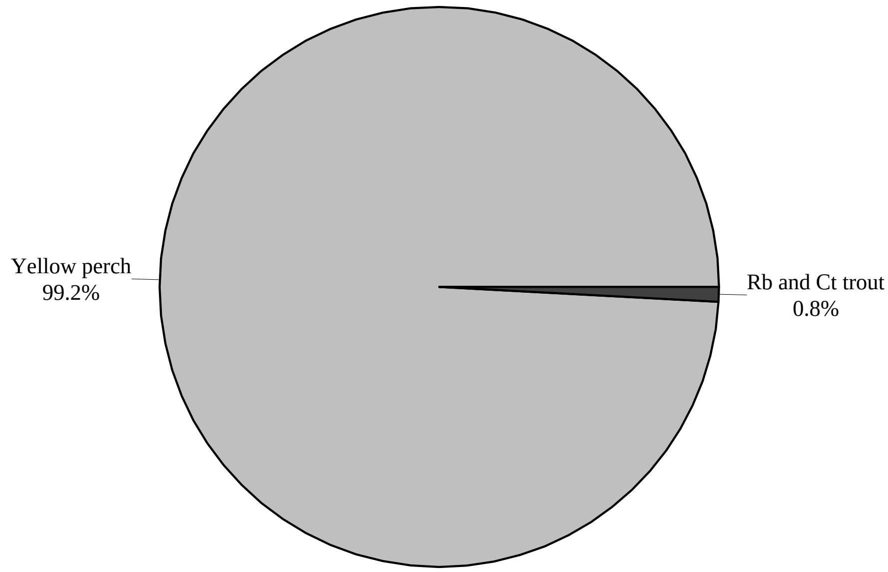


Figure 9. Temperature and dissolved oxygen (DO) profile of Jewel Lake, Idaho, on August 21, 1998. Suitable trout habitat was defined as DO greater than 5 ppm and temperature less than 21°C.

Sample Number



Sample Weight

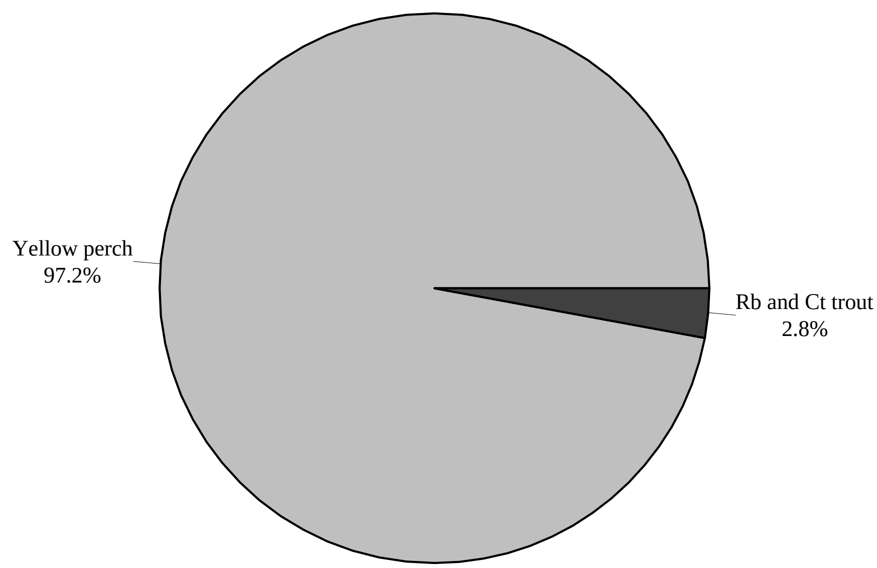


Figure 10. Relative species composition, by total weight and number, of fish collected during the standard lowland lake survey of Jewel Lake, Idaho, 1998.

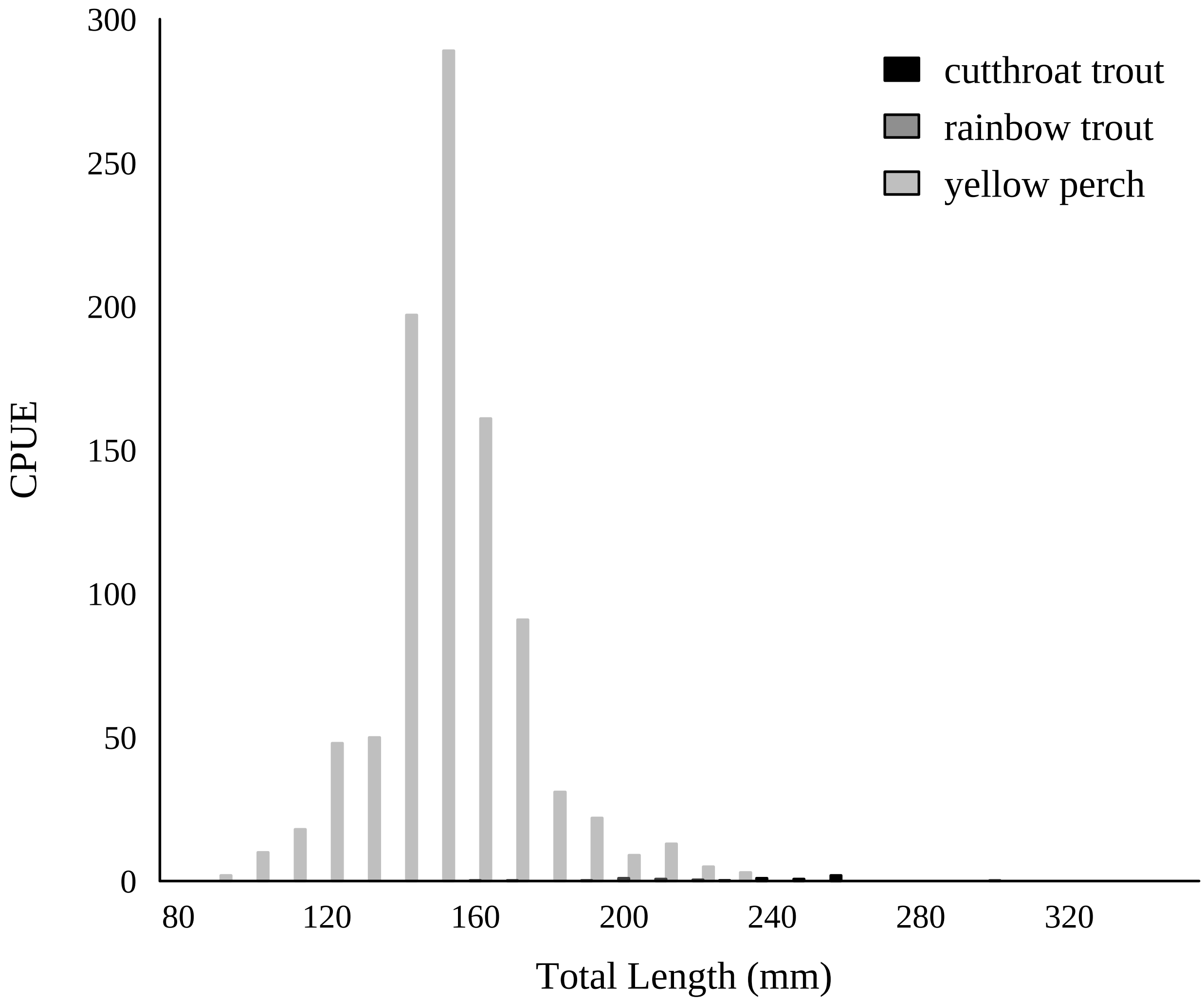


Figure 11. Length frequency of yellow perch, rainbow, and cutthroat trout collected during the standard lowland lake survey of Jewel Lake, Idaho, 1998.

Table 10. Comparison of Jewel Lake, Idaho, fishery characteristics between 1992 (Horner et al. 1996) and 1998 based on standard lowland lake survey samples.

Sample Characteristic	1992	1998
Yellow perch component (by weight)	32%	97%
Yellow perch component (by number)	32%	99%
Modal size of yellow perch	220 mm	150 mm
Maximum size of yellow perch	310 mm	239 mm
Size range of age-4 trout	310-340 mm	240-260 mm
Percent of trout >300 mm	27%	16%

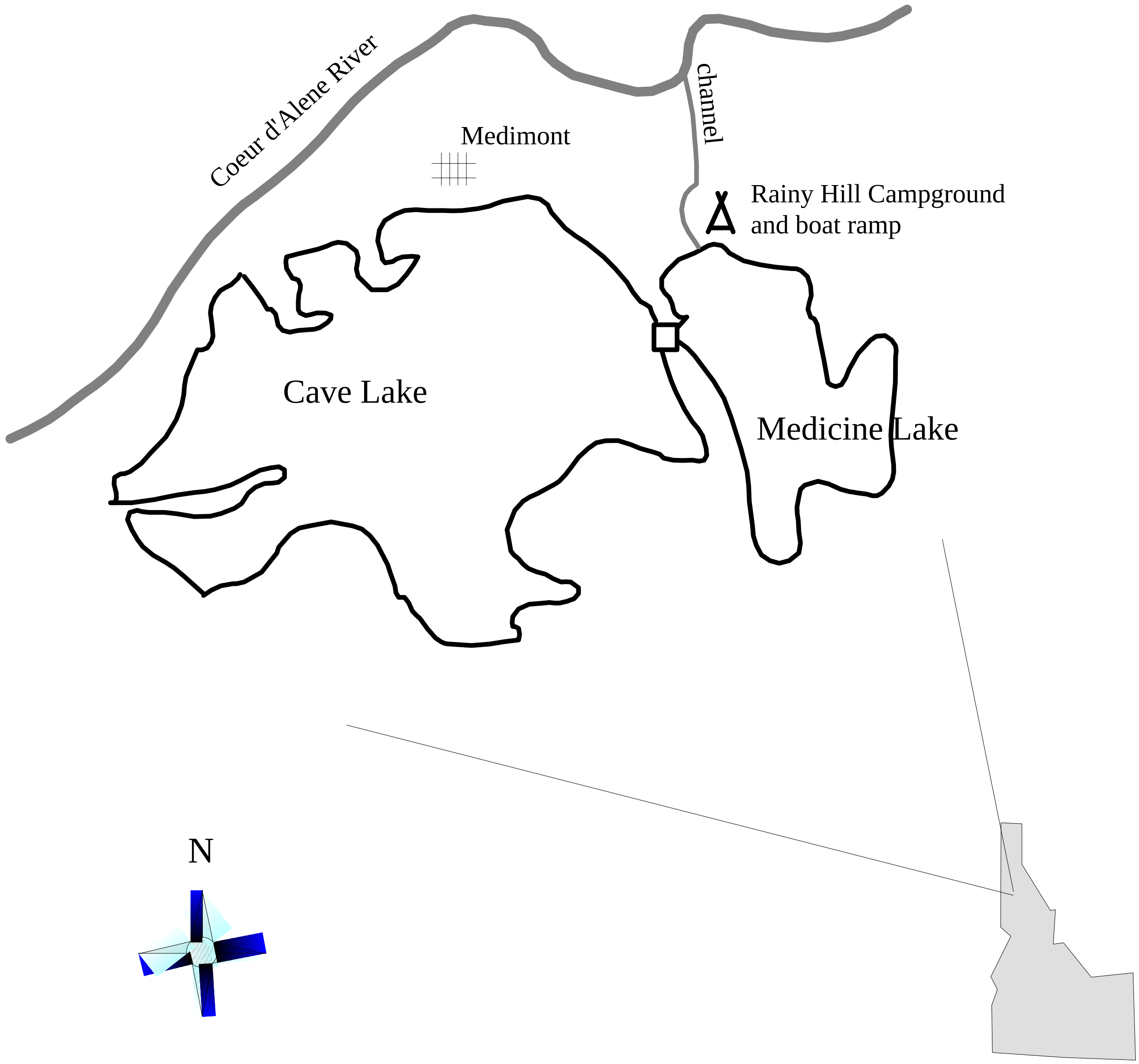


Figure 12. Location of Cave and Medicine lakes, Kootenai County, Idaho.

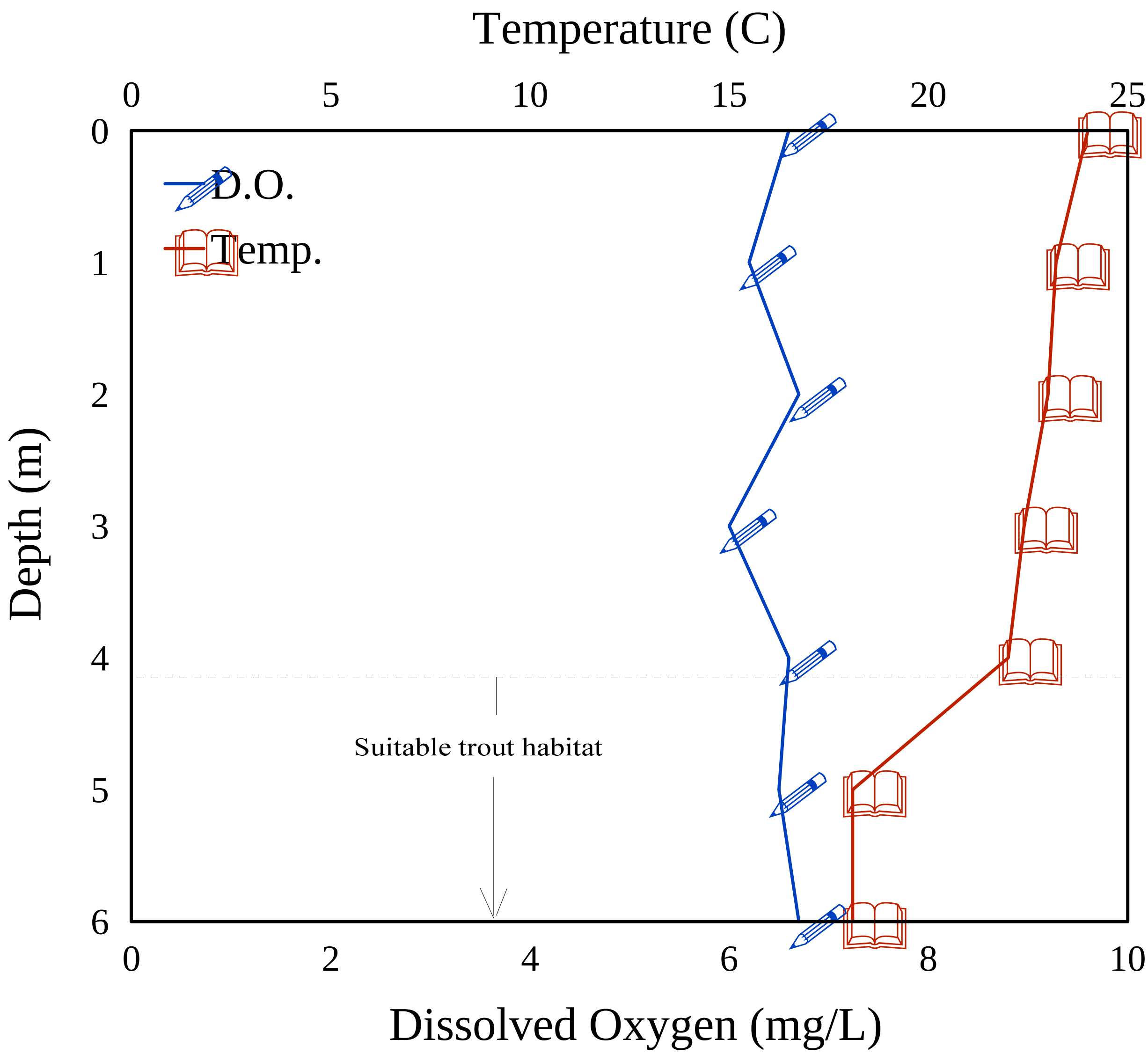


Figure 13. Temperature and dissolved oxygen (DO) profile of Cave Lake, Idaho, on July 7, 1998. Suitable trout habitat was defined as DO greater than 5 ppm and temperature less than 21ºC.

Fishery Characteristics-We sampled a wide range of fish species in Cave Lake, including (in order of abundance based on weight) tench *Tinca tinca*, bullheads *Ameiurus spp*., largemouth bass, yellow perch, northern pike *Esox lucius*, black crappie *Pomoxis nigromaculatus*, largescale sucker *Catostomus macrocheilus*, pumpkinseed *Lepomis gibbosus*, northern pikeminnow *Ptychocheilus oregonensis*, and cutthroat trout (Figure 14). The catch per unit of combined gear sampling effort was 301 fish, with a total weight of 44.12 kg (Appendix B). Most of the biomass (90%) was comprised of tench, black bullheads *A. melas*, and largemouth bass at 51%, 27%, and 12% of the standard survey sample biomass, respectively. Yellow perch were the most abundant species by number at 48% of the total sample.

Including fish collected during the reward tagging effort, largemouth bass ranged from 50 to 536 mm and weighed from 5 to 2,600 g (Figure 15). Relative weight increased with size of fish (fish were collected primarily before spawning) and ranged from 91 at 250 mm to 104 at 450 mm. Proportional Stock Density (PSD; Anderson 1980) of the standard survey sample was 45, and RSD-P was 4. We aged a total of 115 largemouth bass using scale analysis. Largemouth bass growth was among the more rapidly growing populations in northern Idaho, with fish generally achieving legal size (305 mm) around 4.5 years of age (Table 11). The largest fish collected was 536 mm and estimated to be 16 years old.

Based on the standard survey sample, northern pike, black crappie, black bullheads, and largemouth bass all had size structures sufficient to support fisheries (Table 12). Northern pike ranged from 440 to 580 mm in length and weighed from 530 to 1,500 g. Relative weight ranged from 101 to 120 indicating above average condition. Black crappie ranged from 70 to 290 mm with a modal size of 230 mm. Proportional stock density and RSD-P of black crappie were 89 and 11, respectively. Yellow perch were too small to provide a significant fishery despite their abundance. Of several hundred yellow perch collected, none was greater than 170 mm and modal size was only 90 mm. Proportional stock density of yellow perch was zero. We collected one cutthroat trout (253 mm) during the sampling effort, indicating some use of coldwater salmondids.

Creel Survey-We estimated a total of 10,061 angler hours from April through September on Cave Lake, for an average of 0.2 hours/ha/day. Cave Lake received the least effort of the three surveyed lakes (Table 13). During nine of twelve days in July, August, and September, we counted no anglers on the lake, perhaps because of the dense macrophyte cover and/or the wind exposure. We interviewed 84 anglers, of which 92% were Idaho residents. Boat anglers comprised 75% of the angling effort, and largemouth bass were the single most sought after species. Forty-three percent of the interviewed anglers specified largemouth bass (or largemouth bass and northern pike) as their target species. Of the 84 anglers, 74% harvested no fish, and only 6% harvested largemouth bass, although 21% had caught and released at least one bass. Only one angler had harvested more than one largemouth bass at the time of the interview, and none had harvested the daily limit of five. We estimated that 28% of the angling effort was during bass or pike tournaments. Black crappie comprised 70% of the harvest (by number) with largemouth bass, northern pike, yellow perch, and bullheads each contributing 6-9%. Because of the tremendous variability in angler effort and harvest, the estimate of total largemouth bass harvest is not particularly useful (452 $\pm$616), although it does encompass the estimates of harvest and exploitation rate based mark-recapture and tag returns.

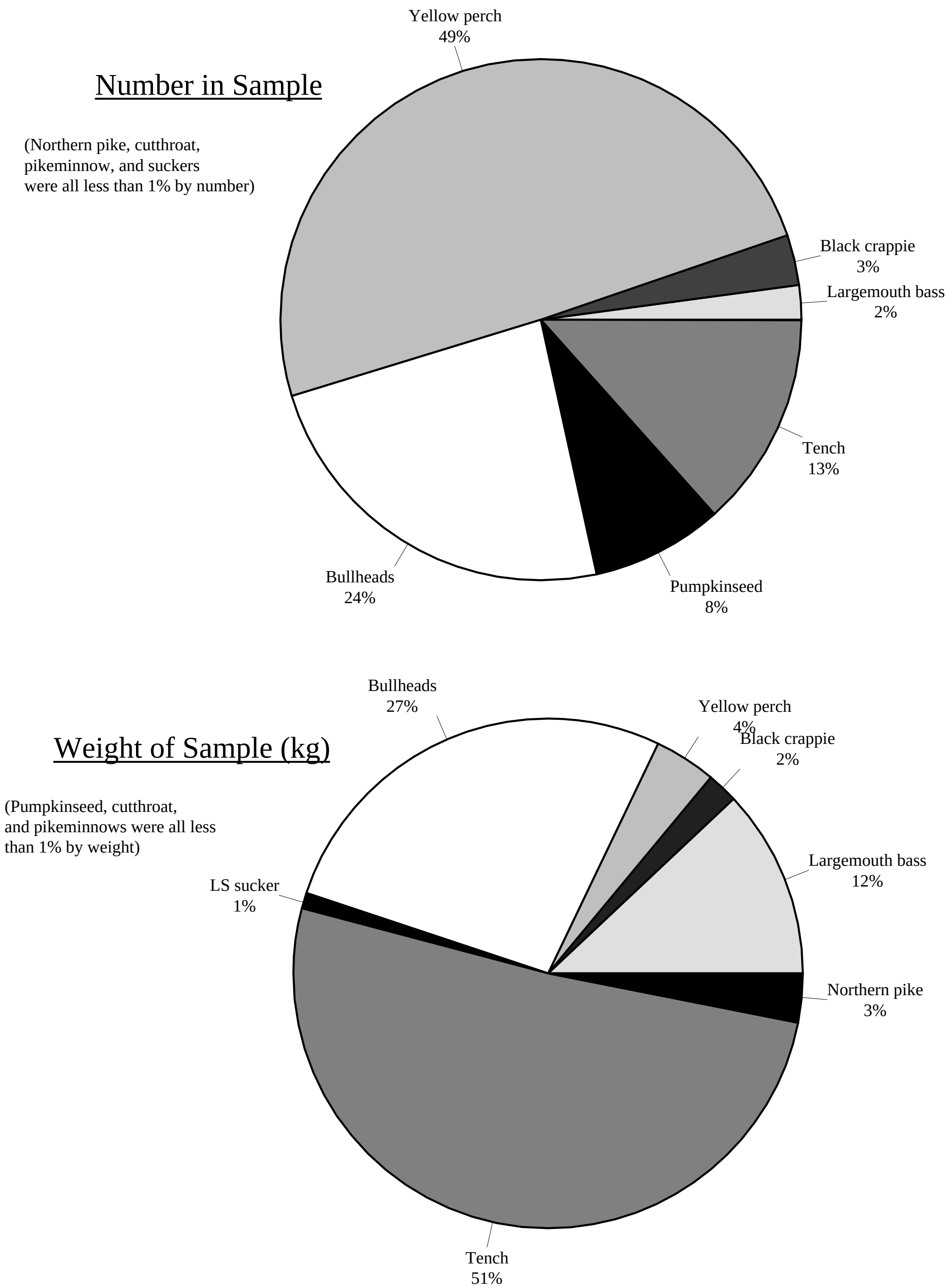


Figure 14. Relative species composition, by total weight and number, of fish collected during the standard lowland lake survey of Cave Lake, Idaho, 1998.

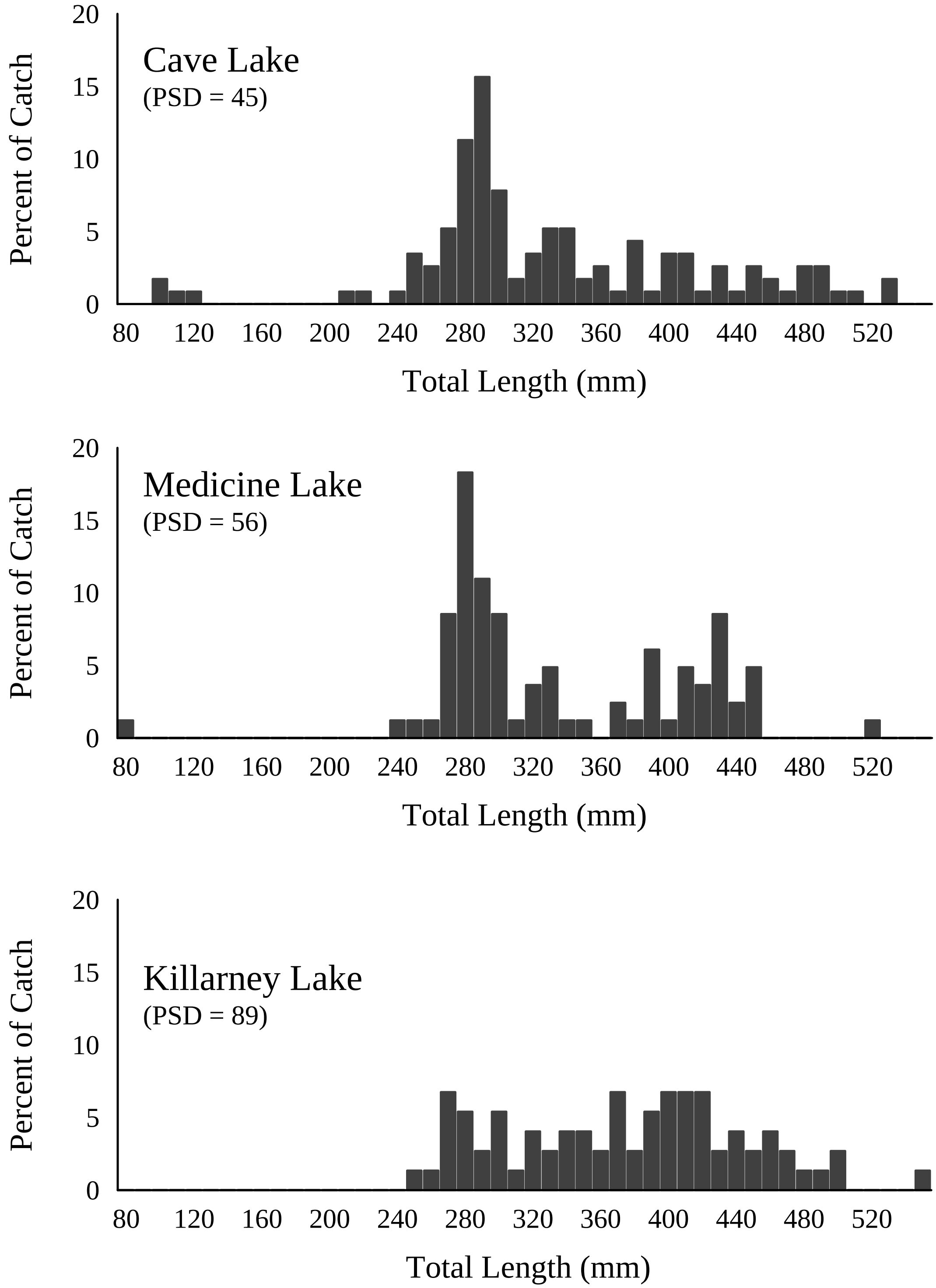


Figure 15. Length frequency of largemouth bass collected during the mark-recapture and standard lowland lake surveys of Cave, Medicine, and Killarney lakes, Idaho, 1998.

Table 11. Back-calculated weighted mean length-at-age of largemouth bass collected in Cave, Medicine, and Killarney lakes, Idaho, in 1998, as compared to regional means throughout the state (Dillon 1991).

	Length at annulus formation									
Location	I	II	III	IV	V	VI	VII	VIII	IX	X
Cave	66	124	202	273	318	357	400	425	454	469
Medicine	59	118	189	270	311	350	390	413	441	--
Killarney	70	146	220	281	329	364	387	441	468	480
Region 1 mean	72	145	206	260	303	325	380	414	432	--
Region 2 mean	77	139	195	254	298	345	--	--	--	--
Region 3 mean	93	192	263	294	357	422	--	--	--	--
Region 4 mean	97	193	238	313	361	369	441	482	--	--
Region 5 mean	108	188	248	287	339	379	414	452	471	--

Table 12. Fishery characterstics based on 1998 standard lake surveys of Cave, Medicine, and Killarney lakes, Idaho.

Species	Parameter	Cave	Medicine	Killarney
Largemouth bass	Range (TL)	50-536 mm	200-518 mm	280-540 mm
	Modal size	300 mm	290 mm	410 mm
	PSD	45	56	89
	RSD-P	4	9	67
	Relative weight	91-104	93-121	94-112
Northern pike	Range (TL)	440-580 mm	400-670 mm	490-800 mm
	Modal size	--	520 mm	--
	PSD	50	25	57
	RSD-P	0	0	7
	Relative weight	101-120	100-116	72-112
Black crappie	Range (TL)	70-290 mm	80-240 mm	70-310 mm
	Modal size	230 mm	210 mm	90
	PSD	89	100	100
	RSD-P	11	0	100
	Relative weight	86-92	--	88
Yellow perch	Range (TL)	60-170 mm	60-290 mm	70-210 mm
	Modal size	90	80	80
	PSD	0	1	6
	RSD-P	0	0	0
	Relative weight	91-108	80-85	89-104
Bullheads	Range (TL)	180-290 mm	180-280 mm	140-270 mm
	Modal size	230 mm	240 mm	200 mm
	PSD	74	65	7
	RSD-P	0	0	0
	Relative weight	--	--	--

Table 13. Results from 1998 creel surveys of Cave, Medicine, and Killarney lakes, Idaho.

Survey Parameters		Cave	Medicine	Killarney
Estimated Effort (April-Sept.)	Total hours	10,061	16,454	23,367
	Hours/ha/day	0.2	1.0	0.6
% of anglers:	Resident	92	90	97
	Nonresident	8	10	3
	Fishing from shore	25	43	53
	Fishing from boats	75	57	47
% of anglers fishing primarily for:	Largemouth bass	43	32	15
	Northern pike	42	18	67
Percent of anglers harvesting:	1 bass	5	3	<1
	2 bass	1	0	0
	More	0	0	0
Percent of total harvest by species:	Largemouth bass	8	40	1
	Northern pike	9	30	36
	Bullheads	7	-	59
	Black crappie	70	30	4
Percent of largemouth harvested from:	April 1- June 30	63	90	100
	July 1 - Sep 30	37	10	0
% of effort during tournaments:		28	4	5

Medicine Lake

Lake Characteristics and Management-Medicine Lake is located immediately east of Cave Lake (Figure 12). The two lakes are actually adjoined by a channel beneath the Medimont Road bridge. Medicine Lake is also connected to the Coeur d=Alene River by an approximately 0.5 km channel. The lake is accessed either by a boat ramp at the U.S. Forest Service (USFS) Rainy Hill Campground, or by way of the river and channel (only during summer elevation). About 75% of the lake is surrounded by public roads (Highway 3, North and South Medimont roads), and the lake is easily accessed for shoreline angling. Much of the shoreline angling takes place at the bridge between Cave and Medicine lakes and at the Rainy Hill Campground.

The shoreline of Medicine Lake is variable. There are residences along the unroaded eastern and southern portions of the lake. The northeastern and southern bays of the lake are shallow with a broad littoral zone marked by dense submersed, floating and emergent macrophytes. The roaded shorelines are rip-rapped or basaltic bedrock. Evans Creek, a degraded coldwater ecosystem, enters Medicine Lake on the southern end.

Limnological Characteristics-Maximum depth of Medicine Lake is around 6.4 m, and mean depth is approximately 4 m at summer elevation (648.6 m). Total dissolved solids was 20 mg/L, and we estimated the MEI at 1.5. Water conductivity near the surface was 30 umHOS. The lake was clearly stratified in the deepest basin of the lake (southeastern bay). The relatively cold water (14-17^{o}C) and oxygen levels (8 mg/L) of the hypolimnion indicate some suitable coldwater fish habitat in Medicine Lake (Figure 16). Secchi disk visibility averaged 3.5 m.

Fishery Characteristics-Not surprisingly, we sampled the same diversity of fish species in Medicine Lake as in Cave Lake, although relative abundance was different (Figure 17). The catch per unit of combined gear sampling effort was 332 fish with a total weight of 56.7 kg (Appendix C). As with Cave Lake, most of the biomass (86%) was comprised of tench, bullheads, and largemouth bass. Unlike Cave Lake, largemouth bass were the second most abundant species (by weight) at 27% of the sample biomass. Tench and bullheads comprised 38% and 21%, respectively. Black crappie, northern pike, and yellow perch all comprised 3-5% of the sample biomass. As in the Cave Lake sample, yellow perch were the most abundant species by number at 47% of the total.

Including fish collected during the reward tagging effort, largemouth bass ranged from 200 to 518 mm and weighed from 100 to 2,700 g (Figure 15). Relative weight was above average and increased with size of fish (fish were collected primarily before spawning) and ranged from 93 at 250 mm to 121 at 518 mm. Proportional Stock Density of the standard survey sample was 56, and RSD-P was 9. We aged a total of 81 fish using scale analysis. As with Cave Lake, largemouth bass growth was among the more rapidly growing populations in northern Idaho with fish achieving legal size (305 mm) in around 4.5 years (Table 11).

Based on the standard survey sample, northern pike, black crappie, black bullheads, and largemouth bass all had size structures sufficient to support fisheries (Table 12). Northern pike ranged from 400 to 670 mm in length and weighed from 390 to 1,890 g. Relative weight ranged from 100 to 116, indicating above average condition. Black crappie ranged from 80 to 240 mm, with a modal size of 210 mm. Proportional stock density and RSD-P of black crappie were 100 and 0, respectively. Yellow perch were too small to provide a significant fishery despite their abundance. Only one yellow perch was

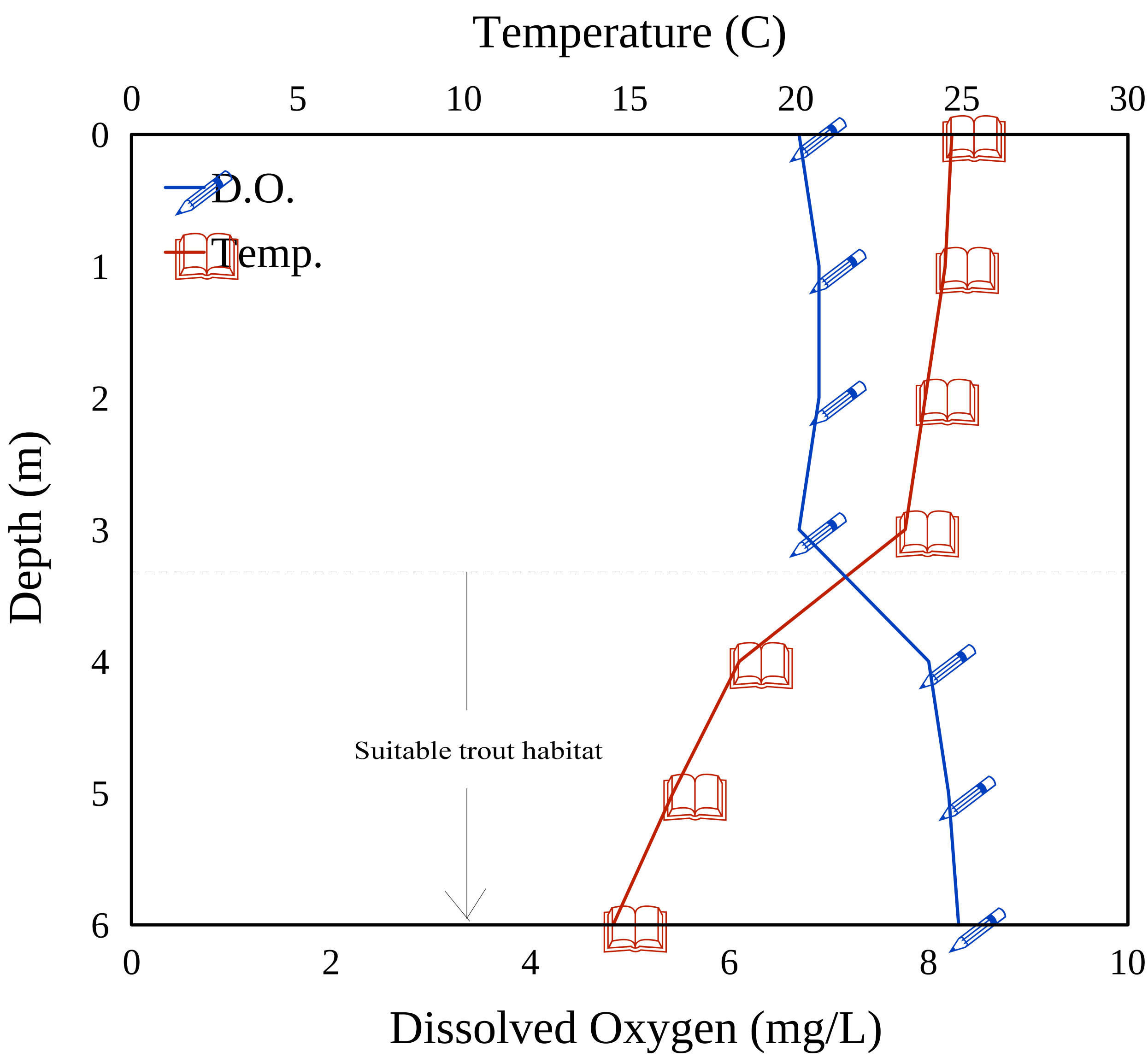


Figure 16. Temperature and dissolved oxygen (DO) profile of Medicine Lake, Idaho, on July 7, 1998. Suitable trout habitat was defined as DO greater than 5 ppm and temperature less than 21°C.

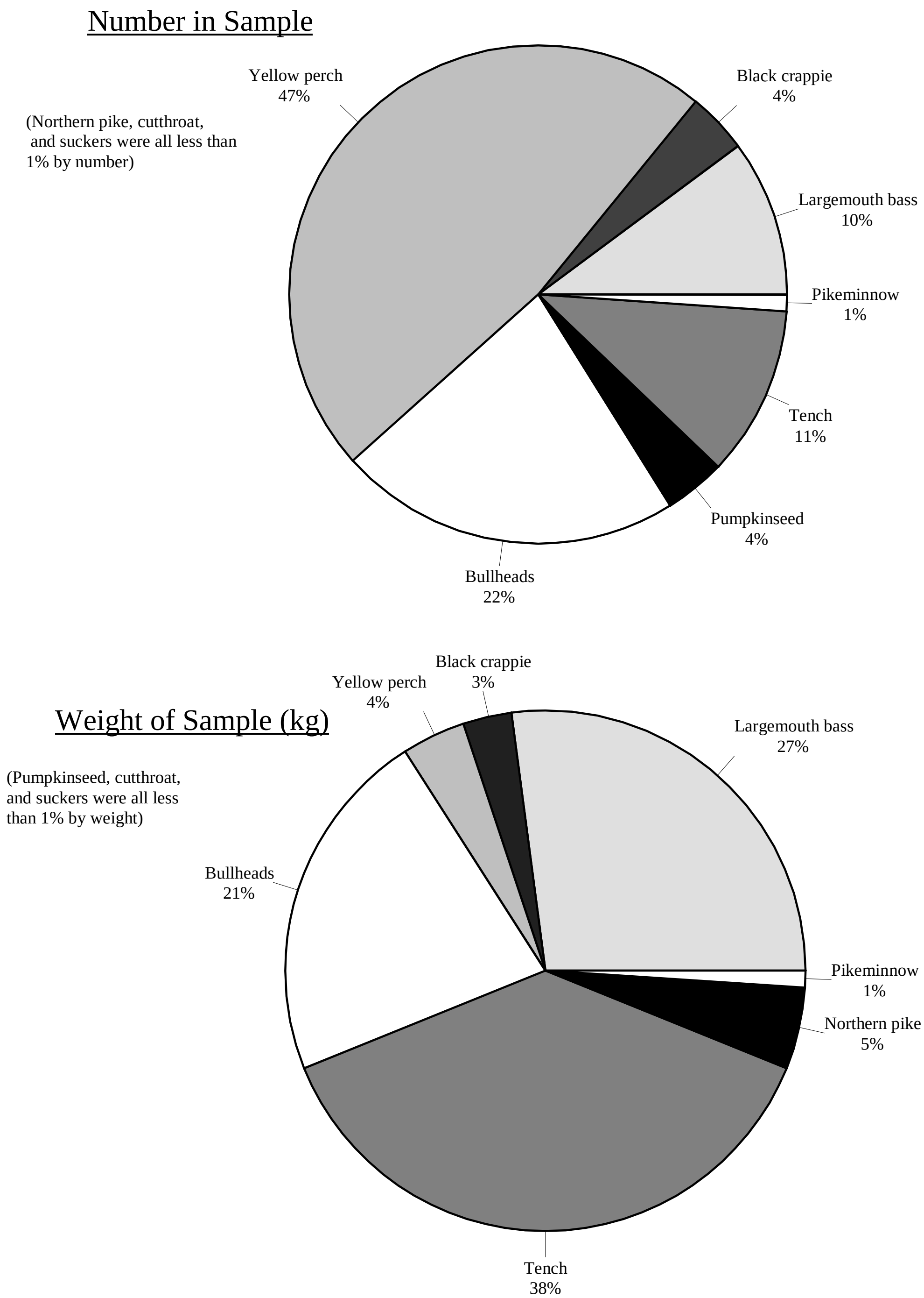


Figure 17. Relative species composition, by total weight and number, of fish collected during the standard lowland lake survey of Medicine Lake, Idaho, 1998.

over 200 mm and modal size was only 80 mm. Proportional stock density of yellow perch was one. We collected one cutthroat trout (260 mm) during the sampling effort, indicating some use of coldwater salmonids, perhaps from Evans Creek.

Creel Survey-We estimated a total of 16,454 angler hours from April through September on Medicine Lake, for an average of 1.0 h/ha/day. This is an approximate 40% increase in effort from 1981, when a creel survey was conducted from April through October (Rieman 1987). Killarney Lake was the most heavily fished of the three surveyed lakes (Table 13). We interviewed 108 anglers, of which 90% were Idaho residents. Boat anglers comprised most of the effort (57%), and largemouth bass were the single most sought after species. Thirty-two percent of the interviewed anglers specified largemouth bass (or largemouth bass and northern pike) as their target species, whereas 18% specified northern pike (or northern pike and another species). Of the 108 anglers surveyed, 88% harvested no fish, and only 3% harvested largemouth bass. No anglers had harvested more than one largemouth bass at the time of the interview. We estimated that 4% of the angling effort was during bass or pike tournaments. As with Cave Lake the estimate of total largemouth bass harvest (423∀437) is too inaccurate to be useful because of the tremendous variability in angler effort and harvest.

Killarney Lake

Lake Characteristics and Management-Killarney Lake is the furthest boat accessible lateral lake up the Coeur d=Alene River (Figure 18). Surface area at summer elevation is approximately 202 ha. The Bureau of Land Management (BLM) maintains a boat ramp and campground (fee required) on the southeastern shore. Boat access is also provided through an approximately 0.5 km channel to the Coeur d=Alene River. Several boat camping sites are located around the lake, the most developed of which is on Popcorn Island (also maintained by the BLM).

Most of the eastern shore of the lake is open to public access, although the bank is steep and only a couple of trails lead down from the county road. Most shoreline angling takes place at the campground and boat launch area. About half of the Killarney Lake shoreline is owned by the BLM and USFS, and the other half is privately owned. A small portion of the privately owned land has been developed with seasonal and year-round homes. Much of the Killarney Lake shoreline is steep and comprised of timber and bedrock. The remaining shoreline, mainly along the bays, is shallow with a broad littoral zone marked by dense submersed, floating and emergent macrophytes.

Limnological Characteristics-At summer elevation (648.6 m), maximum depth of Killarney Lake is around 4.5 m, and mean depth is approximately 2.5 m. Total dissolved solids was 20 mg/L, and we estimated the MEI at 2.4. Water conductivity near the surface was 40 umHOS. The lake was not strongly stratified and temperature and DO declined gradually with depth (Figure 19). Very little water was suitable cold water fish habitat (<21^{o}C; DO >5mg/L). Secchi disk visibility averaged 2.75 m.

Fishery Characteristics-We sampled all of the same species in Killarney Lake as in Medicine Lake and Cave Lake and in addition collected a single bluegill *Lepomis machrochirus*. The catch per unit of combined gear sampling effort was 395 fish, with at total weight of 43.7 kg (Appendix D). Unlike Cave and Medicine lakes, the majority of the biomass in the Killarney Lake sample was largescale suckers (28%) and bullheads (28%), and only 7.5% was tench. Largemouth bass were the third largest contributor of biomass (15%), followed by northern pike (12%) and yellow perch (8%; Figure 20). As in

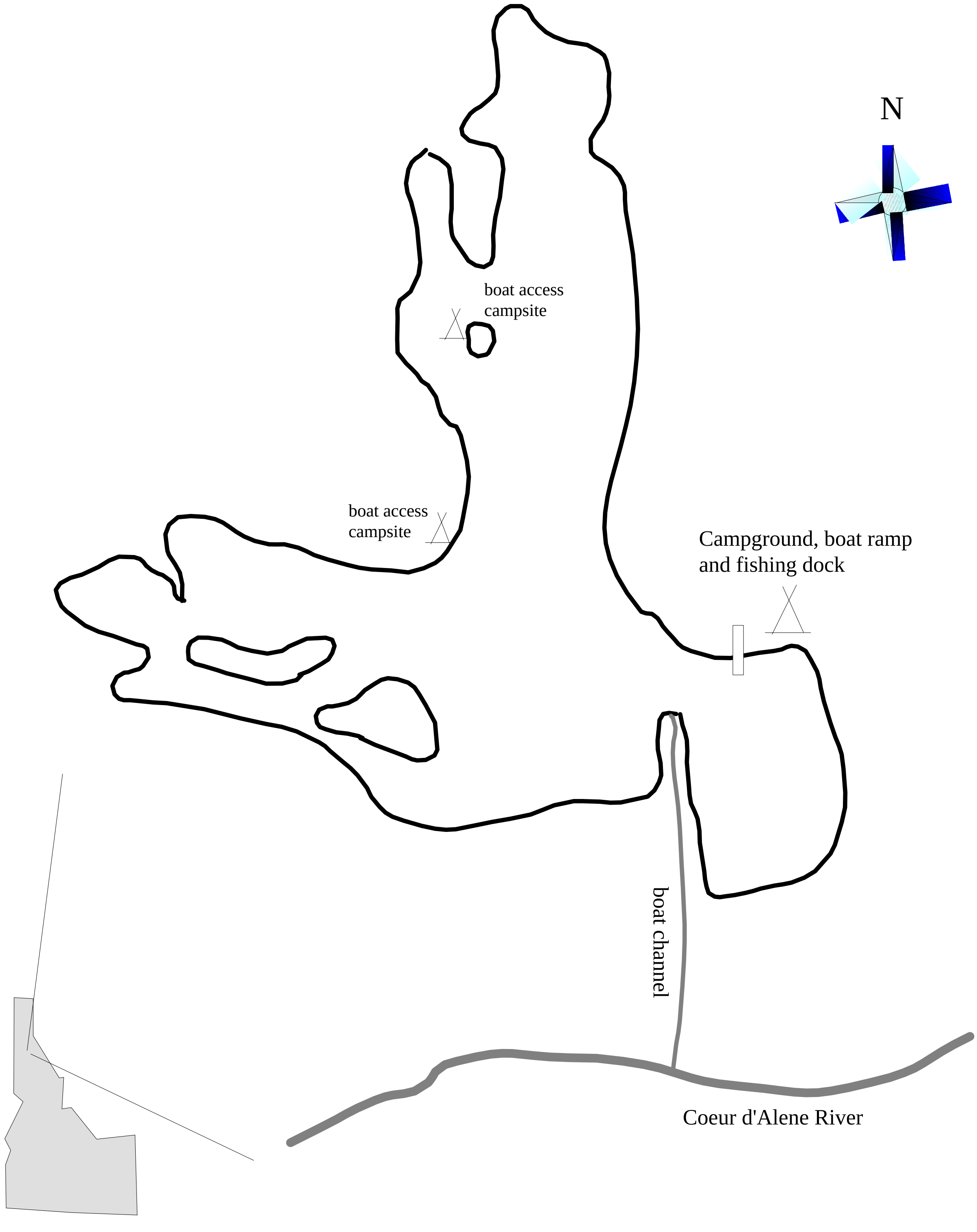


Figure 18. Location of Killarney Lake, Kootenai County, Idaho.

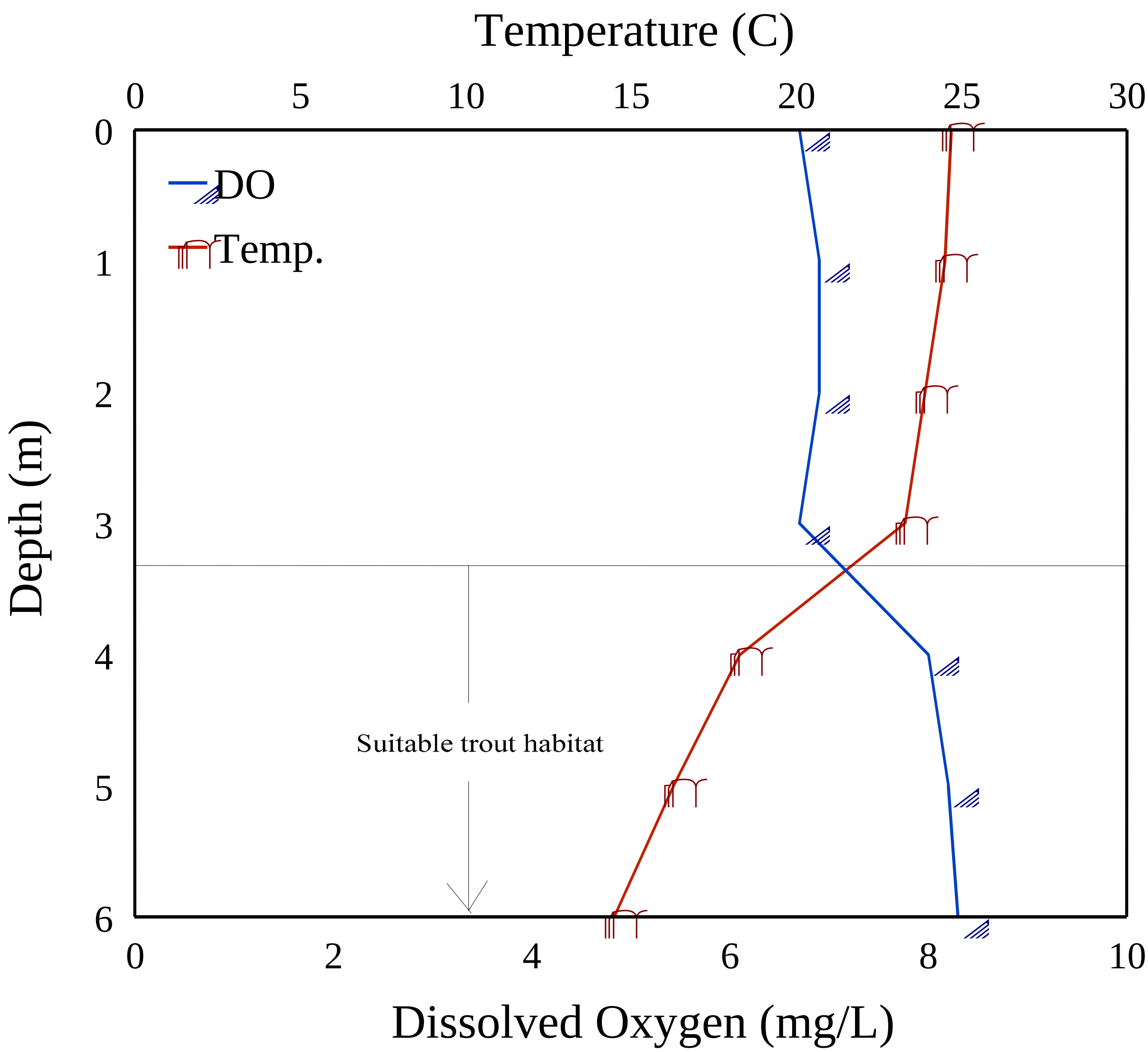


Figure 19. Temperature and dissolved oxygen (DO) profile of Killarney Lake, Idaho, on July 7, 1998. Suitable trout habitat was defined as DO greater than 5 ppm and temperature less than 21°C.

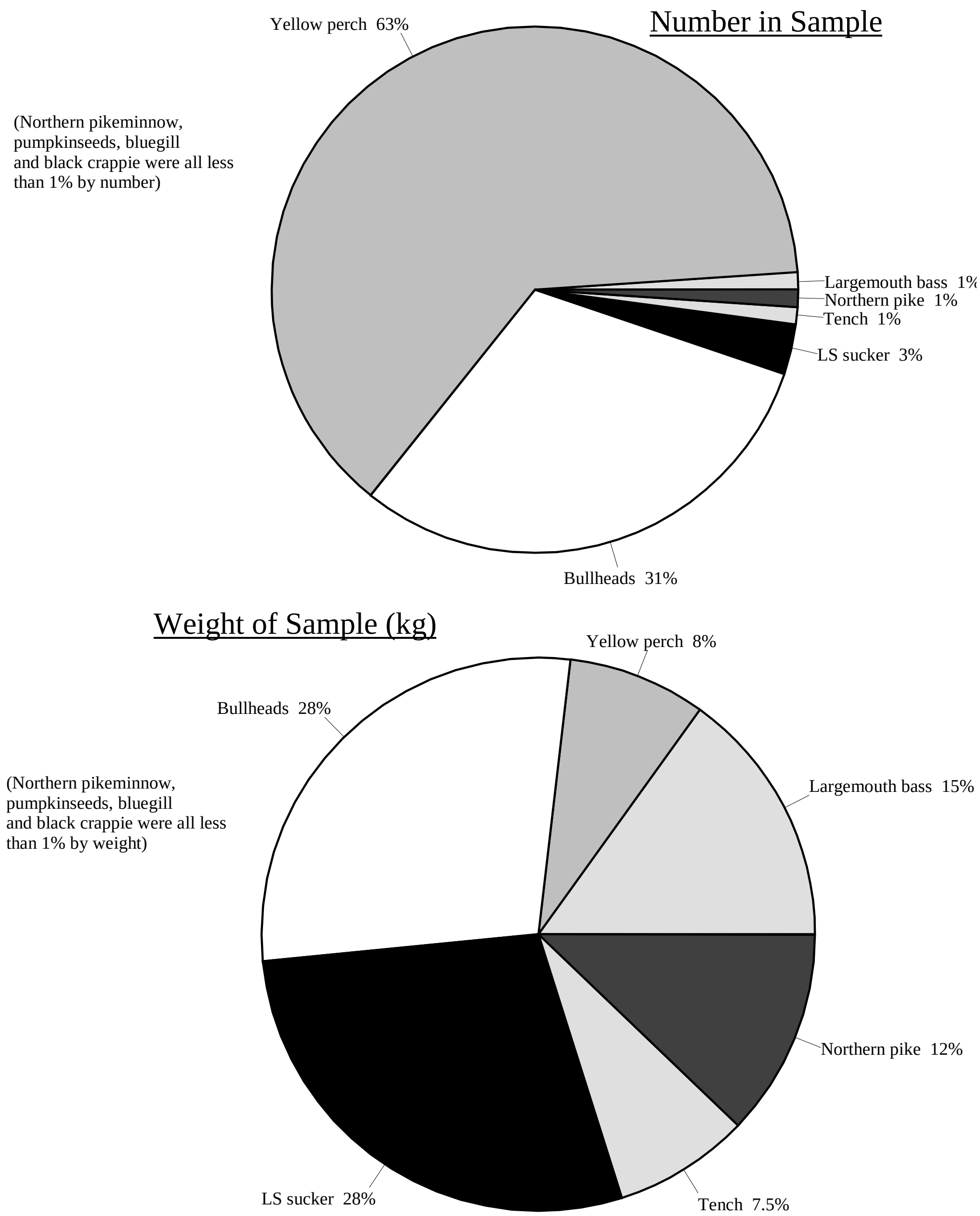


Figure 20. Relative species composition, by total weight and number, of fish collected during the standard lowland lake survey of Killarney Lake, Idaho, 1998.

the other lakes, yellow perch and bullheads were numerically the most abundant species in the sample, at 62% and 31%, respectively. Most yellow perch were too small to provide a fishery. The largest fish collected was 210 mm, and PSD was only 6.

Including fish collected during the reward tagging effort, largemouth bass ranged from 280 to 540 mm, and weighed from 290 to 2,700 g (Figure 15). Relative weight was above average and increased with size of fish (fish were collected primarily before spawning) and ranged from 94 at 250 mm to 112 at 520 mm. Size structure of largemouth bass in the Killarney Lake sample indicated an abundance of large fish, and few juveniles. Proportional Stock Density of the standard survey sample was 89, and RSD-P was 67. We aged a total of 70 fish using scale analysis. Based on scale analysis, largemouth bass growth was the most rapid of the three surveyed lakes, with most fish achieving legal size at age-4 (Table 11). Three fish over 500 mm were estimated to be 10-12 years old.

Based on the standard survey sample, northern pike, black crappie, bullheads, and largemouth bass all had size structures sufficient to support fisheries (Table 12). Northern pike ranged from 490 to 800 mm in length and weighed from 730 to 3,150 g. Black crappie ranged from 70 to 310 mm, with a modal size of 90 mm. Proportional stock density and RSD-P of black crappie were both 100 (these indices, however, are a function of sample size, as the only stock-size fish captured was also over the Apreferred size≅ of 250 mm). Yellow perch ranged from 70 to 210 mm and, similarly to Cave and Medicine lakes, were too small to provide much of a fishery despite their abundance. Proportional stock density was 6, and modal size was only 80 mm. The bullhead stock in Killarney Lake, as indicated by PSD and modal size, was of a lesser quality than Cave or Medicine lakes. Modal size and PSD were both much lower in Killarney Lake than in the other two lakes (Table 12). We did not assess whether the size structure was a function of growth rates or density of bullheads in Killarney Lake or attributed to the popularity of the bullhead fishery and a higher exploitation rate.

Bluegill were stocked in Rose Lake by the Department in 1990. Rose Lake is a closed system during normal flows, and during spring flood events there is likely fish passage to the Coeur d=Alene River. The bluegill in our sample likely either emigrated from Rose Lake during high water or were transported in an angler’s livewell and released illegally. Either way, their presence suggests that bluegill may eventually establish populations throughout Coeur d=Alene and the lateral lakes.

Creel Survey-We estimated a total of 23,367 angler hours from April through September on Killarney Lake for an average of 0.64 h/ha/day. Although Killarney Lake received the greatest number of hours of effort, because of the larger size it was not as heavily fished as Medicine Lake (Table 13). We interviewed 171 anglers, of which 97% were Idaho residents. Unlike Cave and Medicine lakes, the majority (53%) of the angling pressure was from shoreline anglers, and northern pike were the single most sought after species. Two thirds of the interviewed anglers specified northern pike (or northern pike and another species) as their target species, and only 15% specified largemouth bass (or largemouth bass and northern pike). Four percent of the anglers were targeting bullheads. Of the 171 anglers surveyed, 69% harvested no fish, and only one had harvested a largemouth bass at the time of the interview. We estimated that 5% of the angling effort was during bass or pike tournaments. Bullheads and northern pike comprised 95% of the estimated harvest during the survey period (59% and 36%, respectively).

Largemouth Bass Population Dynamics

Mortality and exploitation-Mortality estimates varied, depending on what age-classes were included in the analysis. We believe that inclusion of age-4 to age-9 fish produced the least biased mortality estimate (Figure 21). Total mortality was highest in Cave Lake, where the total instantaneous mortality rate (Z) was 0.37, and total annual mortality (A; e^{-z}) was 31%. Mortality was lowest in Killarney Lake, where total instantaneous mortality was 0.15 and total annual mortality was 14%. Medicine Lake yielded the most variable mortality estimates because of the nonlinear shape of the descending limb of the catch curve, however, the mortality estimates were comparable to the other lakes when we used the same age-classes in the analysis. Total instantaneous mortality was 0.29, and total annual mortality was 25%.

Based on reward tag returns, exploitation in all of the lakes in the Coeur d=Alene system included in the tagging effort was low. Of 433 largemouth bass with reward tags, 26 were harvested and reported, for an estimated exploitation of 6%. An additional 47 fish were reported as caught and released (11%). Estimated harvest varied significantly between lakes (Chi-square test, $P<0.005$). Exploitation in Cave, Medicine, and Killarney lakes was 13%, 7%, and 0%, respectively (Table 14). There was no indication that smaller largemouth bass were exploited at a higher rate than larger size classes (Chi-square test, $P>0.1$). In fact, 9% of the 400-499 mm fish were harvested, compared to only 3% of the 300-399 mm fish.

Most largemouth bass harvest was prior to July 1. Based on tag returns, 69% of the harvested fish were caught before July 1. The lateral lakes creel survey results indicate a similar result, with 77% of the largemouth bass harvest occurring from April through June (Table 13).

Natural mortality was a greater mortality component than exploitation in all three surveyed lakes (Table 14). The instantaneous rate of natural mortality (M) ranged from 0.15 to 0.22, meaning that the annual probability of a fish dying of natural causes was 18% in Cave and Medicine lakes and 14% in Killarney Lake.

Population size-Estimated population of legal-size largemouth bass (>305 mm) in Cave, Medicine, and Killarney lakes were 736, 490, and 538, respectively (Table 14). Based on these estimates, density of legal largemouth bass ranged from 2.6 fish/ha (Cave and Killarney lakes) to 5.3 fish/ha (Medicine Lake). We also estimated the number of sublegal largemouth bass. Few fish less than 250 mm were collected in the April-June efforts. We therefore, restricted the estimate of sublegal fish to those from 250 to 304 mm. Densities of this size-class ranged from 0.2 to 3.2 sub-legal fish/ha, increasing the estimated total density of all largemouth bass over 250 mm to 6.6, 6.9, and 2.6 for Cave, Medicine, and Killarney lakes, respectively. Angler and electrofishing recaptures demonstrated that largemouth bass movement between Cave and Medicine lakes is common, suggesting the two lakes should not be considered closed populations. We therefore combined mark-recapture information from these two lakes and conducted population estimates of Cave and Medicine as a single lake. Density of legal, sublegal, and total largemouth bass was 3.6, 2.0, and 6.6 fish/ha, respectively.

Growth-We also converted length-at-age information to age-at-length for comparison to previous largemouth bass work in Idaho (Dillon 1991). Mean age-at-300 mm for Cave, Medicine, and Killarney lakes was 4.3, 4.5, and 4.0 years, respectively, which is comparable to the 1989-90 statewide average (4.4 years). Age-at-400 mm was 6.7, 6.9, and 6.3 years, slightly lower than the statewide average of 6.2 years.

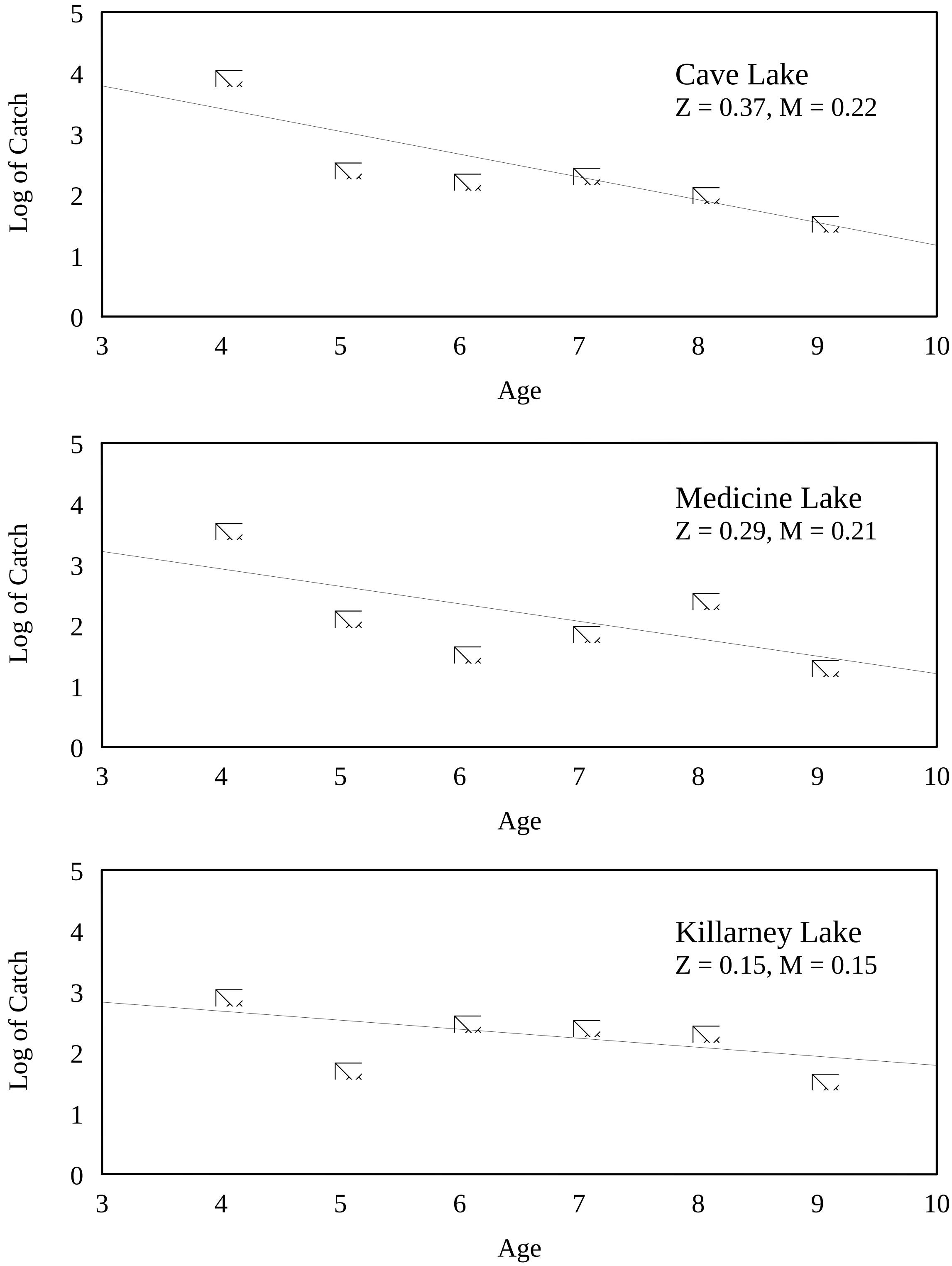


Figure 21. Catch curves of largemouth bass used to estimate total instantaneous mortality (Z) and total annual mortality (M) of Cave, Medicine, and Killarney lakes, Idaho, 1998.

Table 14. Population characteristics of largemouth bass from Cave, Medicine, and Killarney lakes, Idaho, based on 1998 survey.

Population Characteristic		Cave	Medicine	Killarney
Total mortality	instantaneous (Z)	0.37	0.29	0.15
	annual percentage (A)	31	25	14
Fishing mortality	instantaneous (F)	0.19	0.06	--
	annual exploitation (E)	13%	7%	--
Natural mortality	Instantaneous (M)	0.22	0.21	0.15
	annual percentage (D)	18	18	14
Population estimate	Fish >305 mm (95% CI)	736 (224 - 1,248)	490 (34 - 946)	538 (118 - 958)
	Fish >250 mm (95% CI)	1,877 (755 - 3,000)	641 (268 - 1,014)	527 (182 - 872)
Density	Fish >305 mm/ha	2.6	5.3	2.6
	Fish >250 mm/ha	6.6	6.9	2.6
Age at 300 mm		4.3	4.5	4.0
Age at 400 mm		6.7	6.9	6.3

Officer Creel Survey

Conservation officers collected creel survey information from 489 residents and 41 nonresidents, for a total of 530 anglers on 24 regional lakes and sloughs in 1998. In total, 694 angler hours were represented over 104 days in the lakes portion of the officer creel survey. Anglers caught 274 rainbow trout, 27 lake trout, six brook trout, five cutthroat trout, one brown trout *Salmo trutta*, 61 black crappie, 272 yellow perch, three largemouth bass and one tench (Appendix E).

DISCUSSION AND RECOMMENDATIONS

Coeur d=Alene Lake Kokanee and Chinook Salmon

The low number of age-2 and age-3 kokanee was not unexpected. Trawling in 1997 indicated low numbers of all kokanee age-classes, with the exception of age-0. We believe this is largely a result of high runoff events during the winter of 1996 and spring of 1997. Despite the low abundance, anglers were generally pleased with the kokanee fishery because of the large size of fish. Adult (age-3) kokanee abundance in 1999 will likely be comparable to 1998 with low numbers of larger than average fish. Fry abundance in 1998 was comparable to the previous average, indicating that increased fecundity and fry survival helped to compensate for the low escapement in 1997. Escapement in 1998, however, was only around a third of that in 1997. Trawling in 1999 will help to evaluate whether or not such compensatory increases will be sufficient to produce an average year-class of fry. Until we have data to confirm such resiliency, chinook salmon stocking should be modified to account for the weak kokanee escapement.

The chinook salmon fishery has improved substantially since 1997. Despite the lack of adult fish, anglers are encouraged by the high catch rates of age-1 and age-2 chinook salmon. Over 100 anglers participated in the December derby, which was canceled in 1997 because of the poor fishing and lack of angler interest. Angler interest will likely increase in 1999, and we expect a much higher chinook salmon harvest than in 1997 and 1998. Because of the depressed kokanee population, we have made ongoing efforts to encourage catch-and-keep fishing for chinook salmon despite the obvious low numbers of available fish.

The hatchery fish used to supplement natural chinook salmon production in 1998 (from Priest Rapids Hatchery) spawn later than the Coeur d=Alene stock (mid-late October vs early-mid September). Although the later spawn date might increase fishing opportunities (either in the lake or rivers), there are potential disadvantages. An additional redd survey will likely be necessary because of the prolonged spawning season, and the ability to accurately count redds may be compromised by high flows in October and November. Furthermore, the Priest Rapids fish generally mature later than Coeur d=Alene stock, and might remain in the fishery an additional year. This would likely increase the predatory impact on kokanee, thereby complicating the chinook salmon/kokanee balance.

Recommendations:

1. Stock 40,000 fall chinook salmon in 1999 to supplement the estimated 10,000 wild smolts, thereby reducing the total 1999 age-class to 50,000.
2. Utilize an earlier spawning strain of fall chinook salmon if disease-free eggs are available.
3. Continue to encourage catch-and-keep fishing.
4. Continue to monitor kokanee abundance and length-at-age by midwater trawling.
5. Evaluate compensatory fry production in 1999 and adjust chinook salmon stocking in 2000 accordingly.

Spirit Lake Kokanee

Summer residents continued to complain about the poor kokanee fishing at Spirit Lake. Anglers who were successful reported catching kokanee deeper than usual in both Coeur d=Alene Lake and Spirit Lake. Anglers speculated that warm air temperatures and a deep epilimnion kept kokanee deep, and the poor fishing may have been related to fish depth rather than low populations. Trawl estimates indicate age-3 densities are better than most years since 1990; however, they are still only about half of the average density since 1981.

The abundance of age-3 kokanee in 1998 was not significantly affected by ice fishing, although the spring fishery may have significantly impacted the population. A 1994 creel survey estimated a high level of exploitation of age-3 kokanee (102,000 ∀52%) that resulted in a low spawner escapement. The mean of the age-2 and age-3 population estimates since 1981 indicate an average mortality of around 53%. Because of the lack of predators in the system, most of this mortality is probably due to harvest. These exploitation estimates suggest that, depending on conditions, the quality of the summer fishery could well be related to harvest during the winter and spring fisheries. Other possible factors affecting the kokanee population include the loss of suitable spawning habitat due to lower lake levels in recent years.

The increased efficiency of spreader bars raises questions about comparisons with previous data. We have no way of determining if the trawl net has always failed to open completely or if the net has only recently become less efficient because of water-logged otter boards, incorrect boat speed, or some other factor. The decreasing kokanee numbers in all area lakes might suggest the trawl net is becoming less effective, however the magnitude of the decline is much greater than the loss of efficiency without the spreader bars. For this reason, using identical procedures as those since 1981 will likely give the most comparable population estimates in the future.

Recommendations:

1. Conduct a creel survey on Spirit Lake to assess the contribution of the winter, spring, and summer fisheries to total annual kokanee harvest.
2. Continue to monitor kokanee abundance and length-at-age by midwater trawling.

Jewel Lake

The potential for Jewel Lake as a quality trout fishery is greatly compromised by the overpopulation of yellow perch and the related lack of large trout and slow growth rates. Restoring the growth rates and size structure observed in the 1992 survey is likely dependent on eradication of the yellow perch population. Restoration of the lake using rotenone or other toxicants is a possibility; however, our ability to prevent yellow perch from reestablishing a population in Jewel Lake is doubtful for two reasons. First, we were unable to obtain permission to survey the private ponds upstream from Jewel Lake, but based on an observation of the ponds, we suspect they support yellow perch. Successful renovation would likely require eradication of yellow perch in the inlet stream and the ponds as well as in Jewel Lake. Without the cooperation of the pond owners, renovation would only be effective in eliminating yellow perch from the lake for a period of 3-5 years.

Second, during conversations with Hulquists and other anglers fishing Jewel Lake, it became apparent that many area residents prefer Jewel Lake as a yellow perch fishery and do not support quality trout management. Some anglers claim that yellow perch were illegally introduced following renovation in 1989 and suspect that it would happen again if another renovation project were attempted. Because illegal introductions are not difficult and yellow perch populations are easy to establish, management as a trout-only lake is not possible without angler support.

Aside from chemical renovation and quality trout management, alternatives for management of Jewel Lake include:

1. General trout regulations with put-and-take stocking
2. Stocking tiger muskie *Esox lucius x E. masquinongy* or channel catfish *Ictalurus punctatus* to reduce yellow perch numbers and improve size structure
3. Stocking other warmwater fish (bluegill, largemouth bass) to provide a more diverse fishery
4. A combination of these alternatives.

Recommendations:

1. Manage Jewel Lake as a general regulation trout fishery with put-and-take stocking.
2. Stock channel catfish to reduce yellow perch and provide a more diverse fishery.
3. Assess angler interest in shifting the quality trout fishery to Mirror Lake.

Largemouth Bass Evaluation

Based on our 1998 creel survey and reward tagging assessment, anglers did not overharvest largemouth bass in the Coeur d=Alene system. This is a contrast to previous studies. Our estimates of largemouth bass mortality were much lower than in 1981 when Rieman (1987) estimated total mortality in Medicine Lake at 65%. Three possibilities could explain the apparent decline in mortality. First, our interpretation of the catch curve may have resulted in an overestimate of survival, or conversely, Rieman may have underestimated survival. In both studies, mortality from age-4 to age-6 is much higher than mortality from age-6 to age-9. Inclusion or exclusion of those year-classes in the mortality curves yield vastly different survival estimates. Rieman (1987) used dramatically truncated curves (age-4 to age-6) for his mortality estimates on Medicine Lake but acknowledged that total annual mortality estimates ranged from 45% to 70%, depending on which age-classes were included in the catch curve. Using the same criteria, our total mortality estimates ranged from 20% to 64%.

Secondly, the dynamics of the lateral lakes largemouth bass populations may not lend themselves to accurate estimates of survival based on age-structure analysis. Catch curves are most appropriately used when recruitment is constant from year to year. In fisheries with moderate fluctuations in recruitment, catch curves can be improved by collecting age structure data on successive years and Asmoothing≅ the curve (Ricker 1975). In those instances where recruitment varies widely from year to year (by a factor of 5 or more) it is Apractically impossible to use the usual type of catch curve for estimating survival rate: comparisons must be made within individual year-classes, if at all≅ (Ricker 1975). In the lateral lakes, recruitment is known to be highly variable because of the influence of Coeur d=Alene River flows on the elevation and temperatures of the lakes. Northern Idaho experienced an unusually cool summer in 1993 resulting in poor largemouth bass reproductive success, and an unusually warm summer in 1994, resulting in an abundant year-class. The abundance of those year-classes in 1998 (as age-4, age-5) is likely more of a function of initial recruitment than mortality rates. Consequently, inclusion of one or both of these two year-classes generates radically different and possibly erroneous survival estimates. Large floods in 1996 and 1997 connected the lateral lakes into one large flood plain with unknown impacts on bass distribution and survival.

The final, and we believe the most likely, explanation is the possibility that our estimates are accurate and total mortality has declined since 1981. We had a much lower estimate of exploitation, as determined by tag returns, than was found in the 1981 study. In his study, Rieman attributed most of the total mortality to exploitation, which made up around 90% of the total mortality estimate. Natural mortality was not a large factor. Likewise, we estimated a low natural mortality (14%-18%). Rieman (1987) found a significant positive correlation between total annual mortality and exploitation, indicating the components of natural and fishing mortalities were additive. The relatively low total annual mortality in 1998, therefore, could be the result of an increase in catch-and-release and a decrease in exploitation since 1981. Although not accurately quantified during this study, we observed an awareness amongst anglers of the slow growth rates and low standing stocks available in northern Idaho. In general, the avid largemouth bass anglers contacted in this study were not harvest oriented. Unfortunately, our ability to quantify Arecycling≅ of bass was compromised. Despite offering rewards for tag-returns we are certain that we underestimated the percentage of largemouth bass caught and released due to a lack of reporting. We were disappointed to learn many tournament anglers caught and released tagged fish but did not supply us with the information. The lack of cooperation may have resulted from an indifference to the study or from a fear the data would somehow hinder their ability to conduct tournaments.

Although catch-and-release oriented anglers are urging implementation of more restrictive regulations, we saw little evidence that a regulation change would affect the largemouth bass population. Quality largemouth bass regulations generally include a two-fish limit and a July 1-December 31 season. Based on our creel survey, very few anglers catch and keep more than two bass, and a bag limit would serve little purpose. Exploitation could likely be reduced by a more restrictive season because most of the harvest takes place from April through June. The low overall exploitation, however, does not indicate a need for elimination of the April-June harvest.

Recommendations:

1. Continue general management regulations for largemouth bass in the Coeur d=Alene system.

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APPENDICES

PHOTOCOPY/INSERT APPENDICES A-D

Appendix E. Summary of 1998 impromptu officer creel surveys of Idaho Panhandle Regional lakes.

			Surveyed anglers			Method			Angler catch		
Lake	Month	Days surveyed	Residents	Nonres.	Hours fished	Boat	Shore	Ice	Species	Harvested	Released
Blanchard	April	1	5	0	0	2	3				
Brush	April	1	0	0	0						
Chase	April	3	5	3	0	5	0				
Cocolalla	March	5	34	0	77	0	34		RBT:6, BKT:3, CT:1	6	4
Cocolalla Sl.	March	1	2	0	0	0	2				
	April	3	8	3	12	0	11		CRP:19, CT:1	20	
Dawson	March	1	0	0	0						
Fernan	March	1	13	0	24	0	13		RBT:5, CRP:24, YP:16, LMB:1	46	
	June	1	2	0	12	0	2		RBT:4, PS:2, BH:1, TEN:1		
	November	1	2	0	12	0	2		RBT:1, CRP:6, YP:10		
Freeman	February	1	2	2	16	0	0	4	RBT:13	13	
	April	6	19	2	20	2	19	0	RBT:13, YP:2	15	
Granite	March	1	0	0							
Hayden	August	1	10	0	7	7	0		CRP:2	2	
Kelso	January	2	9	0	20	0	0	3	RBT:22		
	March	1	1	1	2						

Appendix E. Continued.

			Surveyed anglers			Method			Angler catch		
Lake	Month	Days surveyed	Residents	Nonres.	Hours fished	Boat	Shore	Ice	Species	Harvested	Released
L.P. Slough	January	1	2	0	2	0	0	2	RBT:1, YP:1		
	February	1	5	0	0						
	March	5	38	0	33	0	38	0	RBT:18		
LP Slough	April	11	50	1	45	0	51	0	RBT:26, LMB:1	27	
Pend Oreille River	February	2	4	1	8	0	6	0			
	March	2	19	0	28	0	19	0	CT:3		
	April	11	44	5	30	0	49	0	CRP:10, YP:10, CT:3, BRN:1		
Perkins	March	1	0	0	0						
Priest	April	3	18	10	72	18	10	0	LKT:27	27	
Robinson	April	2	7	0	14	0	7	0	RBT:3	3	
Round	February	2	2	1	14	0	1	2	RBT:6, BKT:1	5	2
	March	6	64	4	133	20	48	0	RBT:96, BKT:1	73	35
	April	2	21	1	31	1	21	0	RBT:19, LMB:1	7	12
Sansouci	March	1	0	2	1	0	2	0	RBT:13		
	April	7	15	0	7	0	15	0			
Sinclair	April	2	9	0	14	1	8	0	RBT:36	6	30
Smith	March	2	3	0	6	0	3	0	RBT:2	2	
	April	3	16	1	15	11	12	0	RBT:7		

Appendix E. Continued.

			Surveyed anglers			Method			Angler catch		
Lake	Month	Days surveyed	Residents	Nonres.	Hours fished	Boat	Shore	Ice	Species	Harvested	Released
Spirit	February	2	3	2	2	0	0	2	-		
	March	1	1	0	1	0	1	0	-		
	April	1	6	0	10	1	5	0	YP:3	3	
Spirit	June	1	6	0	4	0	6	0	RBT:1	1	
Lower Twin	January	1	7	1	7	0	0	8	YP:15	15	
	February	1	2	0	0	0	2	0	-		
Upper Twin	January	1	10	1	11	0	0	11	RBT:1, YP:150		
	February	2	3	0	6	0	0	3	YP:42	42	
	March	1	2	0	10	0	0	2	BKT:1, YP:24	25	

1998 ANNUAL PERFORMANCE REPORT

State of: Idaho Program: Fisheries Management F-71-R-23

Project: I-Surveys and Inventories Subproject: I-A Panhandle Region

Job No.: c Title: Rivers and Streams Investigations

Contract Period: July 1, 1998 to June 30, 1999

ABSTRACT

Westslope cutthroat trout *Oncorhynchus clarki lewisi* densities estimated from snorkeling transects in the catch-and-release sections of the North Fork Coeur d=Alene, Little North Fork Coeur d=Alene, and St. Joe rivers in 1998 were 0.95 cutthroat trout/100 m5, 0.65 cutthroat trout/100 m5, and 1.09 cutthroat trout/100 m5, respectively. In the harvest sections of the same rivers, densities were 0.41 cutthroat trout/100 m5, 0.39 cutthroat trout/100 m5, and 0.097 cutthroat trout/100 m5, respectively.

Abundance of westslope cutthroat trout estimated by electrofishing in a section of the harvest area of the St. Joe River was 1,473 cutthroat trout in 1998 (0.13 cutthroat trout/100 m5). Two population estimates were made in the catch-and-release section. In the Copper Creek reach, the estimate was 312 westslope cutthroat trout (0.92 cutthroat trout/100 m5), and in the Simmons Creek reach the estimate was 466 cutthroat trout (1.51 cutthroat trout/100 m5). A comparison of abundance of westslope cutthroat trout >200 mm was made for the Copper Creek reach between electrofishing and snorkeling estimates. The electrofishing estimate was 143 cutthroat trout (0.42 cutthroat trout/100 m5) and the snorkeling estimate was 112 cutthroat trout (0.33 cutthroat trout/100 m5).

The density of westslope cutthroat trout >200 mm in the Upper Priest River was 0.22 cutthroat trout/100 m5, estimated by a combination of angling and snorkeling. Bull trout *Salvelinus confluentus* and brook trout *S. fontinalis* were also found in all sections of the Upper Priest River in relatively low densities. Westslope cutthroat trout were widely distributed in tributaries to the Upper Priest River. Brook trout were also found in several tributaries with the highest concentrations in Ruby and Rock creeks.

Salmonid distribution and abundance were surveyed in twenty-one streams on lands administered by the Bureau of Land Management (BLM). Westslope cutthroat trout densities ranged from 0 to 33.9 cutthroat trout/100 m5. Brook trout were found in eight of the 21 streams surveyed.

Estimates of return-to-the-creel for domestic Kamloops rainbow trout *O. mykiss* for the Moyie River, St. Maries River, and Big Creek (St. Joe River) were 7%, 7%, and 8%, respectively. The return rate for Colorado River rainbow trout stocked in the Moyie River was 3%. None of these return rates met the recommended return rate of 40%.

Department personnel counted 726 bull trout redds in the Pend Oreille Lake drainage in 1998. A total of 45 redds were counted in the Upper Priest Lake drainage and 21 redds were counted in the upper St. Joe River drainage. A total of four bull trout redds were counted in the upper Little North Fork

Clearwater River drainage. Bull trout implanted with radio transmitters traveled from Marble Creek upstream to spawning areas of the upper St. Joe River in 35 to 70 days, arriving by mid-August. They remained in this area for about 14 to 21 days and after spawning migrated downstream to overwinter in Coeur d=Alene Lake. There was a minimum 28.6% post spawning mortality rate for radio-tagged bull trout.

The majority (63%) of the radio-tagged westslope cutthroat trout overwintered downstream of Marble Creek in the St. Joe River in 1998. One fish overwintered upstream of Gold Creek, one fish overwintered near Bird Creek, and one fish remained near the Avery Ranger Station.

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OBJECTIVES

1. Annually estimate trout densities in selected snorkeling transects in the Little North Fork Coeur d'Alene and North Fork Coeur d'Alene rivers, and the St. Joe River. Document trends with previously collected data.

2. Estimate westslope cutthroat trout *Oncorhynchus clarki lewisi* population abundance using electrofishing in the harvest and catch-and-release sections of the St. Joe River and compare these estimates to estimates obtained by snorkeling.

3. Assess movement and critical habitat for bull trout *Salvelinus confluentus* and westslope cutthroat trout in the St. Joe River using radio telemetry.

4. Assess trout species composition, distribution and abundance in the Upper Priest River drainage.

5. Assess annual exploitation rate of trout, using reward tags, in the Little North Fork Clearwater River, Idaho.

6. Assess distribution and abundance of salmonids in selected streams within Bureau of Land Management (BLM) ownership in northern Idaho.

7. Assess the status of spawning bull trout populations in tributaries of Pend Oreille Lake, Upper Priest Lake, St. Joe River, and Little North Fork Clearwater River drainages based on abundance of bull trout redds in selected tributaries.

8. Compare harvest rates between put-and-take sized domestic Kamloops rainbow trout *O. mykiss* and Colorado River strain rainbow trout stocked in the Moyie River, using tag returns.

9. Evaluate return-to-the-creel for put-and-take sized domestic Kamloops rainbow trout stocked in the St. Maries River and Big Creek (tributary of the St. Joe River).

METHODS

Westslope Cutthroat Trout Population Trends

Snorkeling

Biologists snorkeled previously established transects (Lewynsky 1986) in the North Fork and Little North Fork Coeur d'Alene rivers (Figure 1) and the St. Joe River (Rankel 1971) (Figure 2). There were 28, 13, and 35 transects surveyed in the North Fork Coeur d=Alene River, Little North Fork Coeur d=Alene River, and St. Joe River, respectively. The number of westslope cutthroat trout, rainbow trout, and bull trout were recorded for each transect by species and length group, either greater than 300 mm or less than 300 mm. Mountain whitefish *Prosopium williamsoni* were counted as either adults or juveniles,

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Figure 1. General location of snorkeling transects in the North Fork and Little North Fork Coeur d'Alene River, Idaho.

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Figure 2. General location of snorkeling transects in the St. Joe River, Idaho.

with juveniles being less than 150 mm. Northern pikeminnow *Ptychocheilus oregonensis* and suckers *Catostomus spp*. were enumerated. Density estimates were calculated for westslope cutthroat trout, bull trout, and rainbow trout. The length and width (m) of each transect was measured to determine the area (m^2) surveyed. Trout densities were reported as fish/100 m^2.

Electrofishing

St. Joe River-We assessed trout and char population abundance in sections of the harvest and catch-and-release areas of the St. Joe River. In the harvest section, we estimated westslope cutthroat trout abundance from Packsaddle Campground downstream to Marble Creek using the Petersen mark-and-recapture methodology (Ricker 1975). All trout were collected using a Coffelt VVP 15 and a 5,000-watt generator mounted in a drift boat with electrodes suspended from two forward booms. The drift boat floated downstream adjacent to the bank. All collected trout were measured for total length (mm), marked with a hole punch in the caudal fin, and released. We captured and marked trout for two days. Three recapture runs were completed one week later.

Two reaches in the catch-and-release section of the St. Joe River (Copper Creek and Simmons Creek) were surveyed. The Copper Creek reach began at the confluence with Copper Creek extending downstream approximately 1,200 m. The Simmons Creek reach began at milepost 1.8 on Forest Service road 218 (snorkeling transect 26) and extended downstream 1,120 m (Simmons Creek is near the middle of the transect). A canoe was used to float the electrofishing equipment downstream. This method required a minimum of seven people--three netters, three to operate the electrodes and one to control the canoe and safety switch. Electrofishing equipment included a Coffelt VVP 15 and 5,000 watt generator. We used the Petersen mark-and-recapture methodology to estimate trout and char abundance. On the marking runs, each fish was measured (TL) and each trout and char was marked with a hole punch in the caudal fin. The recapture runs were conducted one week later, two in the Copper Creek reach and one in the Simmons Creek reach. All fish collected were measured and examined for marks.

A second method was used to estimate westslope cutthroat trout abundance in the Copper Creek reach. During the marking run, all westslope cutthroat trout longer than 200 mm were tagged with a brightly colored Floy T-bar anchor style tag. The day prior to the first electrofishing recapture run, two snorkelers floated downstream in the Copper Creek reach and counted all westslope cutthroat trout observed. The trout were separated into groups less than 200 mm and greater than 200 mm. The number of tagged trout observed was recorded. The density of westslope cutthroat trout longer than 200 mm was estimated.

Upper Priest River Drainage Assessment

Upper Priest River

We assessed bull trout, brook trout *S. fontinalis*, and westslope cutthroat trout distribution and abundance in the Upper Priest River during July 27-31, 1998. The river was divided into four sections: Section 1 from Upper Priest Lake to approximately 1.6 km above Ruby Creek; Section 2 from approximately 1.6 km above Ruby Creek to Lime Creek; Section 3 from Lime Creek to approximately 300 m above Rock Creek; and Section 4 from approximately 300 m above Rock Creek to upper Priest

River Falls (Figure 3). Fish were captured by hook-and-line on day one. All salmonids were identified and total length was measured. Westslope cutthroat trout over 200 mm were tagged with a brightly colored Floy T-bar anchor style tag. Snorkeling was conducted on day two. All salmonids observed were identified and classified into length groups (0-75, 76-150, 150-199, 200-300, or >300 mm). The numbers of Floy-tagged westslope cutthroat trout were also recorded by length group. Using these data, population and density (trout/100 m^2) estimates for cutthroat trout were calculated for each section using a Petersen mark-recapture estimate.

Upper Priest River Tributaries

Distribution and abundance of bull trout, brook trout, and westslope cutthroat trout were assessed by electrofishing in the tributaries to the Upper Priest River (Figure 3). Each stream was divided into three sections: upper, mid, and lower, and each section was divided into nine reaches. Three reaches per section were randomly selected and nine sites per stream were surveyed, except for four west side tributaries where fewer sites were surveyed due to encountering the Washington State line. Sampling sites were a minimum of 30 m long, and mean stream widths were calculated from five width measurements. A single pass was made through each sampling site to capture trout and char. All trout and char captured were identified to species, and total length was measured. At least one site per stream was selected for a multiple pass depletion estimate (Seber and LeCren 1967) and calculation of density (fish/100 m^2). A comparison was made with 1984 data reported by Irving (1987). Irving=s data was compiled by snorkeling different habitat types, estimating densities for each type, and extrapolating to the entire stream based on the number of habitat units.

Snorkeling was used in the middle section of Hughes Fork. This section was too deep to sample effectively by electrofishing due to numerous beaver dams. The entire Hughes Meadow section (middle) was snorkeled from Jackson Creek to Bench Creek. All trout and char observed were identified and classified by 25 mm length groups.

<u>Fish Population Assessment in Bureau of Land Management Streams</u>

Stream Survey

The BLM and the Idaho Department of Fish and Game (Department) cooperated in a cost-share project to conduct a cutthroat trout inventory survey in several streams in the Emerald Empire Resource Area. Streams were surveyed using the Department Standard Stream Methodology. Each tributary was divided into three sections: bottom, middle, and top. A minimum of one reach was surveyed in each section. Trout population estimates were attempted in each reach using a Smith-Root Model 15-D backpack electrofisher and the multiple removal methodology described by Seber and LeCren (1967). We used two or three passes to complete the removal of trout and char. Species and total length of each trout captured were recorded, and density of all trout combined (trout/100 m^2) was estimated. Captured trout were identified and measured to develop a length frequency.

Each study reach was measured for length (approximately 30 m), mean width (minimum of three measurements), and mean depth (minimum of three sets of four measurements). Substrate composition was assessed at three locations per study reach and combined to indicate relative abundance of substrate

Figure 3. Upper Priest River drainage, Idaho.

classes. Substrate was classified using the modified Wentworth classification (Cummins 1962), except the pebble and gravel categories were combined.

Hatchery Trout Evaluation

Department personnel measured and tagged (with numbered Floy tags) 955 put-and-take sized (fish greater than 230 mm) Colorado River rainbow trout and 948 domestic Kamloops rainbow trout and stocked them into the Moyie River (Figure 4) in early June 1998. We also stocked 300 tagged domestic Kamloops rainbow trout into the St. Maries River in June 1998 and 100 tagged domestic Kamloops rainbow trout into Big Creek (St. Joe River; Figure 5) on July 2, 1998. A reward (either a T-shirt, hat, or $5) was offered for the return of the tag number of a harvested trout. All returns were entered into a drawing for a $100 gift certificate from a sporting goods store of their choice. The number of returned tags were totaled for each body of water and the percentage of trout returned to the creel was calculated.

Bull Trout Spawning Surveys

In 1998, bull trout redds were counted in selected tributaries based on previous surveys of the Pend Oreille Lake (Pratt 1984), Upper Priest Lake (Nelson et al. 1996), St. Joe River (Davis et al. 1996), and Little North Fork Clearwater River (Davis et al. 2000) drainages. We surveyed the Pend Oreille Lake drainage October 9-28; the Upper Priest Lake drainage September 28 to October 2; and the St. Joe River drainage September 21-22. Survey techniques and identification of bull trout redds followed methodology described by Pratt (1984). Inexperienced bull trout redd observers accompanied an experienced observer for a one-day training session. We estimated the number of adult bull trout spawners entering each drainage by applying 2.2 fish/redd (Bonar et al. 1997) to the total number of redds observed.

The BLM and the Department cooperated in a cost share project to conduct a bull trout redd survey on September 23, 1998 in three Little North Fork Clearwater River tributaries: Lund, Little Lost Lake, and Lost Lake creeks, and the upper portion of the Little North Fork Clearwater River between Lost Lake Creek and the headwaters. The goal of the project was to assess adult bull trout spawning escapement.

St. Joe River Bull Trout and Westslope Cutthroat Trout Telemetry

Capture and Tagging Procedures

Bull Trout- Candidate bull trout were captured by electrofishing the St. Joe River from Packsaddle Campground downstream to Marble Creek May 12 to June 19, 1998. Angling and baited hoop nets were also used in an attempt to capture migrating bull trout during the same period.

Bull trout selected for radio transmitters had to weigh a minimum of 700 g so the heaviest transmitter would not exceed 2% of the body weight of the fish. Bull trout were surgically implanted with radio transmitters operating on a frequency of 151.0 MHZ. Fourteen standard transmitters (Model 10-35 from Advanced Telemetry Systems, Inc.) were used; each weighed 10.3 g to 10.8 g and was 54 mm

Figure 4. General location of area stocked with hatchery fish between Meadow Creek and Copper Creek campground, Moyie River, Idaho, 1998.

Figure 5. General location of the St. Maries River and Big Creek in the St. Joe River drainage, Idaho.

long with a 300 mm whip antenna. All transmitters operated at 40 pulses per minute. The standard transmitters were guaranteed for 200 days.

Five additional transmitters (Model 5902 from ATS) were temperature sensitive and each weighed 14.7 g to 15.0 g and was 47 mm long with a 300 mm whip antenna. The temperature transmitters were guaranteed for 250 days of active service. The number of pulses per minute was used to determine water temperature; the higher the number of pulses per minute, the higher the water temperature. The manufacturer suggested timing the duration of 10 pulses and converting the time to milliseconds. This value was located on a table of regression values to determine water temperature. However, after the first two weeks, due to the lack of sensitivity of the regression equation used to produce the table, we timed the duration of thirty pulses and divided by three to provide a more accurate estimate of time to convert to water temperature. Each temperature transmitter had a unique regression table to determine water temperature.

Bull trout selected for implant were anesthetized with clove oil (3 ml:12 L of water) and placed in a nylon mesh cradle ventral side up and the head submerged in the treated water. A large syringe (turkey baster) was used to irrigate the gills alternating between treated and fresh water. A 3 to 4 mm incision was made in the abdomen anterior to the pelvic girdle with a No. 11 surgical blade with a grooved director to guide the depth and direction of the blade. The transmitter was sterilized with alcohol and inserted through the incision into the body cavity. A catheter needle was inserted posterior to the pelvic girdle into the incision where the whip antenna was then threaded through the catheter and pulled outside of the fish when the catheter was removed. The antenna was shortened if it extended past the end of the caudal fin. Three to five sutures using No. 3 sterilized catgut chromic material were tied to close the incision. The incision and exit points of the antenna were bathed in Betadine antiseptic. The fish was placed in a tank of fresh water until it was upright and able to swim away.

Westslope Cutthroat Trout- Candidate westslope cutthroat trout were captured by electrofishing and angling the St. Joe River between Gold Creek and Red Ives Creek from August 26 to September 16, 1998. Implantation of the transmitters followed the same procedure as described for bull trout. Transmitters used for westslope cutthroat trout (produced by ATS and Lotek) operated on unique frequencies in the 148.0 to 149.0 MHz range, weighed 7.2 g to 8.0 g, and were 45 mm long with a 300 mm whip antenna. All transmitters were programmed to be active eight hours per day to extend the life of the battery to a guaranteed 220 days.

Telemetry

Bull Trout- Bull trout were tracked by ground (truck) and airplane (when fish entered the roadless section upstream from Red Ives Creek). A receiver (Model SRX-400 from Lotek Engineering, Inc.) purchased with funds donated by Avista (formerly Washington Water Power) was used to track movements of fish twice a week from June through September 1998 and then once per week until the bull trout exited the river. Personnel from the St. Joe River District, Panhandle National Forest assisted with tracking the fish one day a week. Locations of bull trout were determined by the loudest acoustical signal, and locations were identified by milepost and closest landmark. Aerial flights were also used to track locations of bull trout in the roadless area in the upper portion of the drainage in August and September (five flights). When a temperature transmitter was located, the number of pulses was counted as described. A thermograph was placed in the river at Packsaddle Campground to record water temperatures four times daily from June through October 1998.

<u>Westslope Cutthroat Trout</u> -Tracking began September 9, 1998 and continued into April (when fish began their spawning migration) following the same general procedure as bull trout. Locations of westslope cutthroat trout were identified one day per week by mileposts and landmarks.

RESULTS

<u>Westslope Cutthroat Trout Population Trends</u>

North Fork Coeur d'Alene River

The density of westslope cutthroat trout (estimated by snorkeling) in the North Fork Coeur d=Alene River was 0.95 fish/100 m^2 in the catch-and-release section and 0.41 fish/100 m^2 in the harvest section (Table 1). Summaries of fish observed and fish densities per transect are displayed in Appendices A and B. The density of trout larger than 300 mm TL was higher in the catch-and-release section (0.08 fish/100 m^2) than in the catch-and-keep section (0.01 fish/100 m^2) where the harvest regulation allows one cutthroat trout longer than 350 mm.

Little North Fork Coeur d'Alene River

The density of westslope cutthroat trout estimated by snorkeling in the Little North Fork Coeur d=Alene River was 0.65 fish/100 m^2 in the catch-and-release section and 0.39 fish/100 m^2 in the harvest section (Table 1). No cutthroat trout >300 mm were observed in the Little North Fork Coeur d=Alene River. Appendices C and D display the number and density of trout and char observed per transect.

St. Joe River

Densities of westslope cutthroat trout (estimated by snorkeling) in the St. Joe River were 1.09 fish/100 m^2 and 0.097 fish/100 m^2 in the catch-and-release and the harvest sections, respectively (Table 1). The density of cutthroat trout greater than 300 mm was 0.11 fish/100 m^2 and 0.007 fish/100 m^2 in the catch-and-release and the harvest sections of the St. Joe River, respectively. A summary of fish observed and estimated fish densities for each transect are displayed in Appendices E and F.

Westslope cutthroat trout population abundance (estimated by electrofishing) in a section of the harvest area of the St. Joe River was 1,473 cutthroat trout with a density of 0.13 fish/100 m^2 in June 1998 (Table 2). The westslope cutthroat trout density estimate in the section from Packsaddle Campground downstream to the North Fork St. Joe River was 0.16 fish/100 m^2 and the section from the North Fork St. Joe River downstream to Marble Creek was 0.13 fish/100 m^2 (Table 2). Densities of westslope cutthroat trout longer than 200 mm were 0.06 fish/100 m^2 in the Packsaddle Campground downstream to the North Fork St. Joe River section and 0.09 fish/100 m^2 in the section from the North Fork St. Joe River downstream to Marble Creek (Table 2). Captured westslope cutthroat trout ranged from 100 mm to 410 mm in total length (Figure 6).

Table 1. Summary of westslope cutthroat trout densities counted in snorkeling transects in the North Fork Coeur d'Alene, Little North Fork Coeur d'Alene, and the St. Joe rivers, Idaho, August 1998.

Section	Fish Size	Cutthroat trout counted	Transect length (km)	Number counted/ km	Area (m^2)	No. counted/ 100 m^2
North Fork Coeur d'Alene River						
Catch-and-keep	< 300 mm	245	1.3	188.0	61.255	0.40
	> 300 mm	7	1.3	5.4	61,255	0.01
	Total			193.4		0.41
Catch-and-release	< 300 mm	183	1.2	153	21.005	0.87
	> 300 mm	16	1.2	13	21,005	0.08
	Total			166		0.95
Little North Fork Coeur d'Alene River						
Catch-and-keep	< 300 mm	67	0.6	112	17.047	0.39
	> 300 mm	0	0.6	0	17,047	0
	Total			112		0.39
Catch-and-release	≤ 300 mm	30	0.2	150	4,582	0.65
	> 300 mm	0	0.2	0.0	4,582	0.0
	Total			150		0.65
St. Joe River						
Catch-and-keep	< 300 mm	55	1.6	43.0	60,975	0.09
	> 300 mm	4	1.6	2.5	60,975	0.007
				45.5		0.097
Catch-and-release	< 300 mm	391	1.8	217	39.937	0.98
	> 300 mm	44	1.8	24	39,937	0.11
	Total			241		1.09

Table 2. Population estimates for trout captured by electrofishing in the harvest section of the St. Joe River, Idaho, June 1998.

Reach	Length (m)	Width (m)	Area (m^2)	Species	Length group (mm)	Number trout marked	Number trout captured	Number trout recaptured	Population estimate	Confidence interval (95%)	Density (trout/ 100 m^2)
Packsaddle Campground to North Fork St. Joe River											
	6,400	42	268,000	Cutthroat	100-199	23	42	1	--	--	--
				Cutthroat	200-420	27	84	13	164	103-302	0.06
				Cutthroat	100-420	50	126	14	423	270-765	0.16
North Fork St. Joe River to Marble Creek											
	19,200	43	825,600	Cutthroat	100-199	26	96	8	280	160-631	0.03
				Cutthroat	200-420	42	165	8	775	441-1,743	0.09
				Cutthroat	100-420	68	261	16	1,048	685-1,818	0.13
				Rainbow	100-199	46	87	4	810	393-2,699	0.10
				Rainbow	200-420	21	26	3	--	--	--
				Rainbow	100-420	67	113	7	954	530-2,246	0.12
Packsaddle Campground to Marble Creek											
	25,600	43	1,100,800	Cutthroat	100-199	49	138	9	651	398-1,449	0.06
				Cutthroat	200-420	69	248	21	781	535-1,254	0.07
				Cutthroat	100-420	118	386	30	1,473	1,067-2,175	0.13

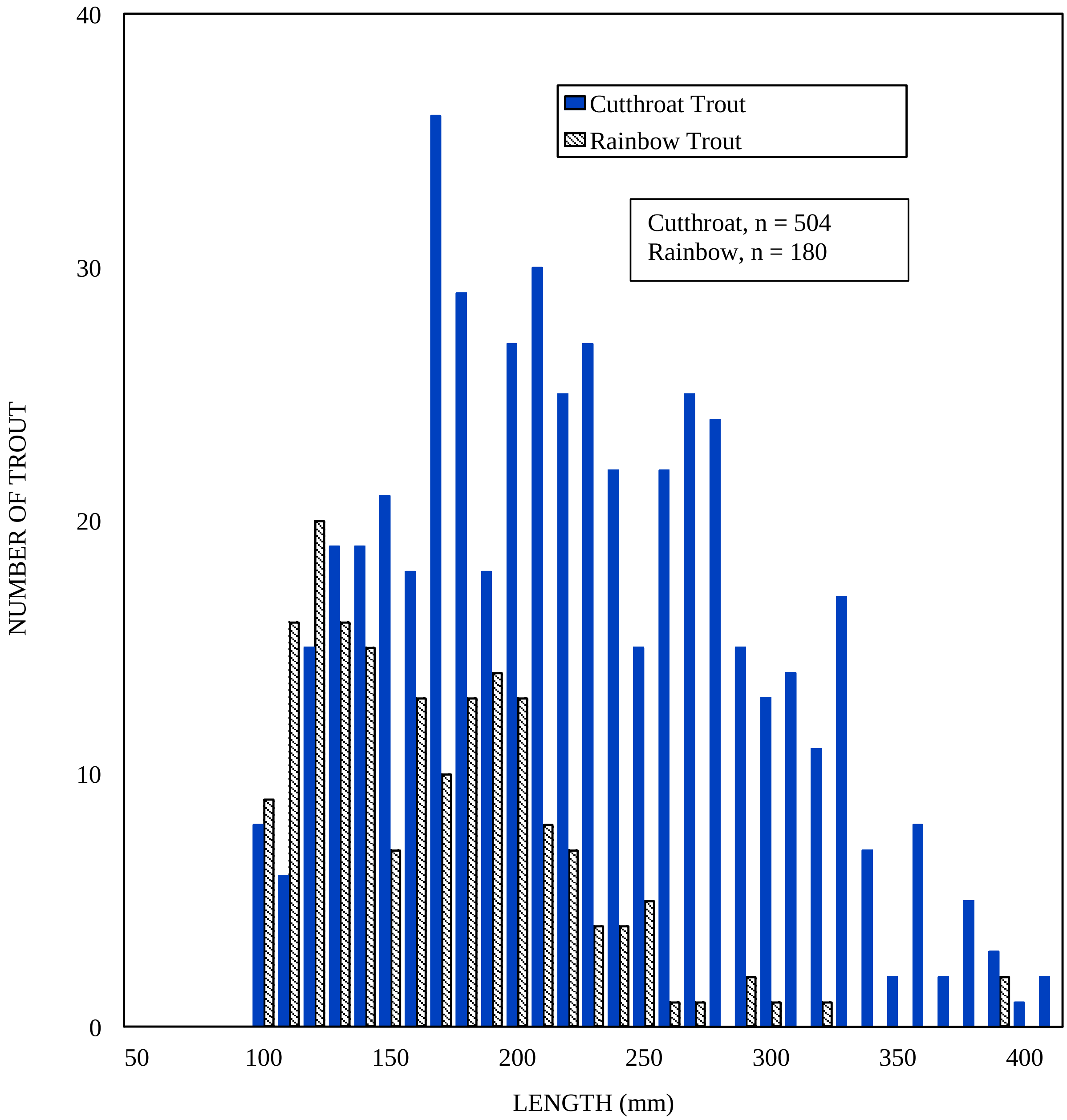


Figure 6. Length frequency of westslope cutthroat and rainbow trout captured by electrofishing in the harvest section of the St. Joe River, Idaho, June 1998.

Westslope cutthroat trout population abundance (estimated by electrofishing) in the catch-and-release sections were 312 and 466 in the Copper Creek reach and the Simmons Creek reach, respectively (Table 3). The density of westslope cutthroat trout in the Simmons Creek reach (1.51 fish/100 m^2) was higher than in the Copper Creek reach (0.92 fish/100 m^2). Lengths of all westslope cutthroat trout captured in the catch-and-release section by electrofishing ranged from 100 mm to 400 mm (Figure 7).

The electrofishing population estimate of westslope cutthroat trout longer than 200 mm in the Copper Creek reach was 143 fish providing a density estimate of 0.42 fish/100 m^2 (Table 3). The snorkeling population estimate of westslope cutthroat trout longer than 200 mm in the same section was 112 fish, providing a density estimate of 0.33 fish/100 m^2 for (Table 3).

The abundance of wild rainbow trout in the St. Joe River between the North Fork St. Joe River downstream to Marble Creek was similar to the westslope cutthroat trout in the same section, 0.12 rainbow/100 m^2 (Table 2). No rainbow trout were captured from Packsaddle Campground downstream to the North Fork St. Joe River or in the catch-and-release study sites. Lengths of captured rainbow trout ranged from 100 mm to 390 mm (Figure 6).

Little North Fork Clearwater River

In August 1997, we tagged 75 westslope cutthroat trout >350 mm in the Little North Fork Clearwater River with Floy T-bar anchor style reward tags. In 1997, three tags were returned; in 1998 three more tags were returned. The minimum exploitation rate for westslope cutthroat trout >350 mm in the Little North Fork Clearwater River in 1998 was 4%. Total return for both years was 8%.

Upper Priest River Drainage Assessment

Upper Priest River

Westslope Cutthroat Trout-We captured 171 westslope cutthroat trout by angling (catch rate = 2.4 fish/h) ranging in length 100 mm to 410 mm (Figure 8). Westslope cutthroat trout were captured and observed in all sections of the Upper Priest River (Table 4). A total of 78 westslope cutthroat trout (∃200 mm) were tagged with brightly colored Floy tags and 47 were recaptured (observed) while snorkeling. The population estimate for westslope cutthroat trout (∃200 mm) in the four river sections ranged between 24 and 185 fish (Table 4). The estimated number of westslope cutthroat trout (∃200 mm) captured and observed by angling and snorkeling, for all the river sections combined, was 374 fish (95% CI = 285 to 508; Table 4). The estimated density of westslope cutthroat trout (∃200 mm) in the surveyed area was 0.22 fish/100 m^2 (Table 4). The estimated density of westslope cutthroat trout ∃200 mm observed by snorkeling only was also 0.2 fish/100 m^2. The density for all length groups of westslope cutthroat trout observed by snorkeling was 0.3 fish/100 m^2 (Table 5).

Bull Trout-Bull trout were observed in all sections of the Upper Priest River. Nine adult bull trout were observed by snorkeling (three in Section 1, three in Section 2, one in Section 3, and two in

Section 4). Based on spotting patterns, one of the adult bull trout observed in Section 1 may have been a bull trout x brook trout hybrid. Juvenile bull trout were observed in Sections 1, 3, and 4. The highest

Table 3. Population estimates for westslope cutthroat trout captured by electrofishing or observed by snorkeling in the catch-and-release section of the St. Joe River, Idaho, August 1998.

Reach	Method	Length (m)	Width (m)	Area (m^2)	M	C	R	Population estimate	Minimum fish length	Confidence interval (95%)	Density (trout/100m^2)
Copper Cr. to Beaver Cr.	Electrofishing	1,280	26.6	34,048	43	57	7	312	100 mm	172-742	0.92
Simmons Cr. to Gold Flat	Electrofishing	1,120	27.5	30,800	52	44	4	466	100 mm	226-1,514	1.51
Copper Cr. to Beaver Cr.	Snorkeling	1,280	26.6	34,048	31	46	12	112	200 mm	69-211	0.33
Copper Cr. to Beaver Cr.	Electrofishing	1,280	26.6	34,048	31	36	7	143	200 mm	79-337	0.42

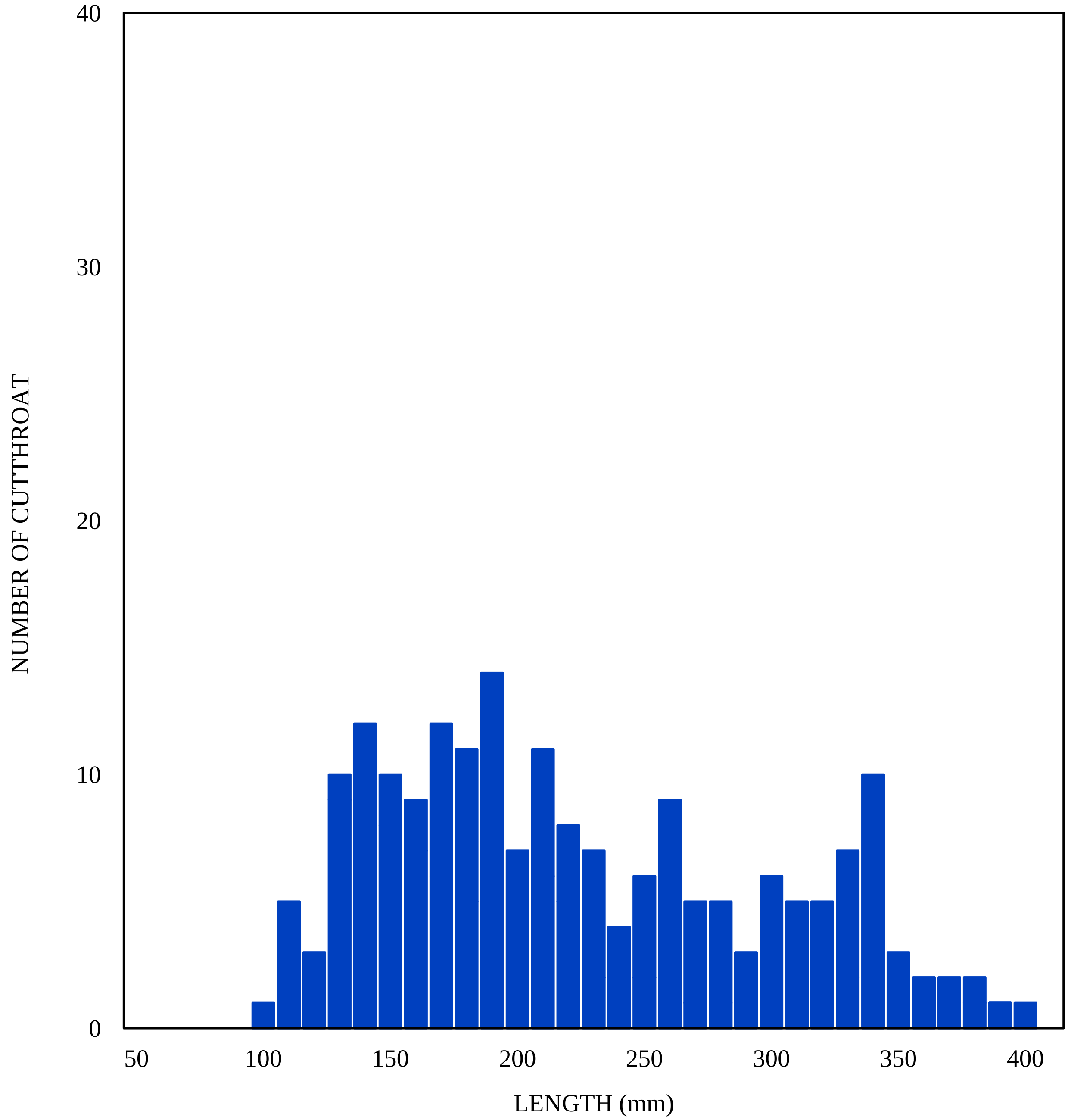


Figure 7. Length frequency of westslope cutthroat trout captured by electrofishing in the catch-and-release section of the St. Joe River, Idaho, August 1998.

Table 4. Population estimates of westslope cutthroat trout >200 mm in length captured by angling and Arecaptured≅ by snorkeling in the Upper Priest River, Idaho, July 1998. Section 1 was from Upper Priest Lake to approximately 1.6 km above Ruby Creek; Section 2 from approximately 1.6 km above Ruby Creek to Lime Creek; Section 3 from Lime Creek to approximately 300 m above Rock Creek; and Section 4 from approximately 300 m above Rock Creek to Upper Priest River Falls.

Section	Length (m)	Width (m)	Area (m^2)	Number cutthroat marked	Number cutthroat captured	Number cutthroat recaptured	Cutthroat population estimate	Confidence interval (95%)	Density (fish/ 100 m^2)
1	2,087	13.7	28,591	14	111	12	131	75-227	0.46
2	3,523	12.8	45,090	10	16	7	24	12-50	0.05
3	4,800	12.0	57,600	11	17	8	25	13-50	0.04
4	4,150	8.6	35,690	43	85	20	185	120-287	0.52
Total	14,560	11.8	166,971	78	229	47	374	285-508	0.22

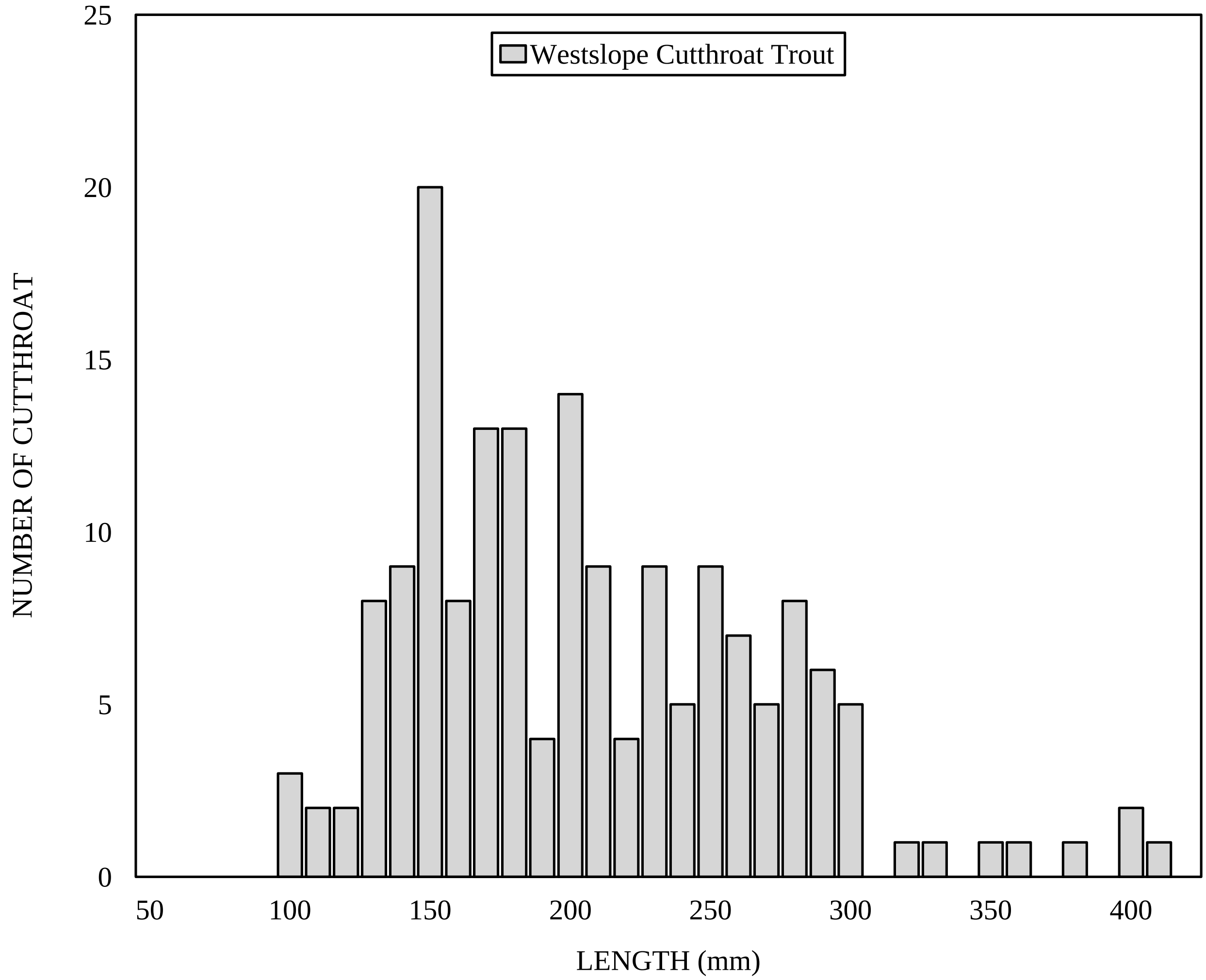


Figure 8. Length frequency of westslope cutthroat trout captured by anglers in Upper Priest River, Idaho, 1998.

Table 5. Percentage of westslope cutthroat trout, bull trout, and brook trout observed by snorkeling in sections of the Upper Priest River and the middle of Hughes Fork, Idaho, July 1998. Density expressed as fish/100 m^2.

		Westslope cutthroat trout			Bull trout			Brook trout		
Stream	Area (m^2)	Number	%	Density	Number	%	Density	Number	%	Density
<u>Upper Priest River</u>										
Section 1-Upper Priest Lake to Ruby Creek	28,591	121	80	0.42	3	2	0.01	27	18	0.09
Section 2-Ruby Creek to Lime Creek	45,090	119	96	0.26	3	2	<0.01	2	2	<0.01
Section 3-Lime Creek to Rock Creek	57,600	126	94	0.22	6	4	0.01	2	2	<0.01
Section 4-Rock Creek to Upper Priest River Falls	35,690	145	81	0.41	32	18	0.09	1	1	<0.01
Total	166,971	511	--	0.31	44	--	0.03	33	--	0.02
<u>Hughes Fork</u>										
Section 2-Jackson Creek to Bench Creek	18,900	25	100	0.13	0	0	0	0	0	0

concentration of juvenile bull trout was in Section 4 and all juvenile fish observed were less than 300 mm in length. The density of bull trout observed by snorkeling in Upper Priest River was 0.03 fish/100 m^2 (Table 5).

Brook Trout - Brook trout were found in all sections of the Upper Priest River, although in relatively low densities. The estimated density of brook trout observed by snorkeling in the Upper Priest River was 0.02 fish/100 m^2 (Table 5). The greatest number of brook trout was found in Section 1 (27 fish). Nineteen of these brook trout were less than 150 mm and the largest brook trout observed by snorkeling was approximately 250 mm. Brook trout comprised 2% or less of the trout and char community in sections 2, 3, and 4 (Table 5).

Upper Priest River Tributaries

Boulder Creek-The only salmonid species captured in the nine reaches surveyed in Boulder Creek in 1998 was westslope cutthroat trout (Figure 9). Depletion estimates were made in three reaches (all located above a barrier waterfall approximately 1 km upstream from the mouth). The estimates ranged between 3.7 fish/100 m^2 and 7.3 fish/100 m^2 (Table 6). Captured cutthroat trout ranged in length from 40 mm to 270 mm (Figure 9).

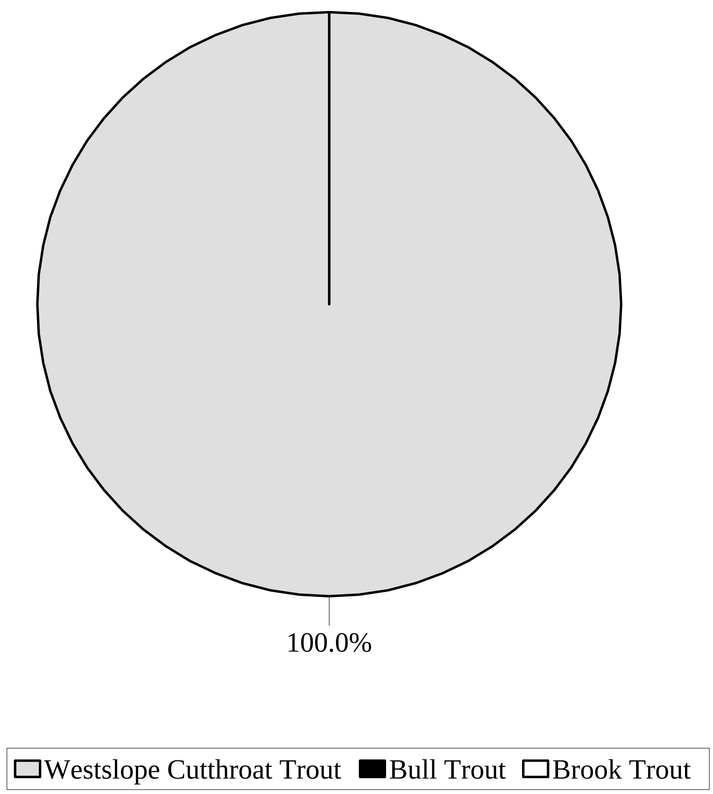
The 1998 estimated density for westslope cutthroat trout by electrofishing (5.4 ∀3.0 fish/100 m^2) was lower than the 1984 density estimate (18.0 ∀12.6 fish/100 m^2) made by snorkeling (Irving 1987; Table 7). Bull trout and brook trout comprised 10% and 2.8 % of the salmonids observed by Irving (1987) in 1984. The sampling effort in 1998 did not detect any brook trout or bull trout, indicating that their abundance may be very low (Table 8).

Gold Creek-Westslope cutthroat trout and bull trout were captured in the five reaches surveyed in 1998 in Gold Creek below a waterfall barrier (located approximately 4.5 km upstream from the mouth). No fish were captured above the barrier. Cutthroat trout comprised 36% of the salmonids captured and bull trout 64% (Table 8). Cutthroat trout ranged in length from 80 mm to 280 mm, and bull trout ranged in length from 30 mm to 190 mm (Figure 10).

In 1984, westslope cutthroat trout comprised 49% of the salmonids observed by snorkeling, bull trout comprised 21%, and brook trout 30%. In 1998, cutthroat and bull trout were collected, but no brook trout were captured (Table 8).

South Fork Gold Creek-Westslope cutthroat trout was the only salmonid captured in the one reach surveyed in South Fork Gold Creek in 1998, located below a waterfall barrier (Figure 11). No fish were captured above the barrier. Captured westslope cutthroat trout ranged in length from 50 mm to 140 mm (Figure 11).

Muskegon Creek-Westslope cutthroat trout was the only species of salmonid captured in the three reaches surveyed in 1998 in Muskegon Creek and the estimated density was 8.7 fish/100 m^2 (Table 6). The lengths of captured cutthroat trout ranged from 50 mm to 160 mm (Figure 12). There was a



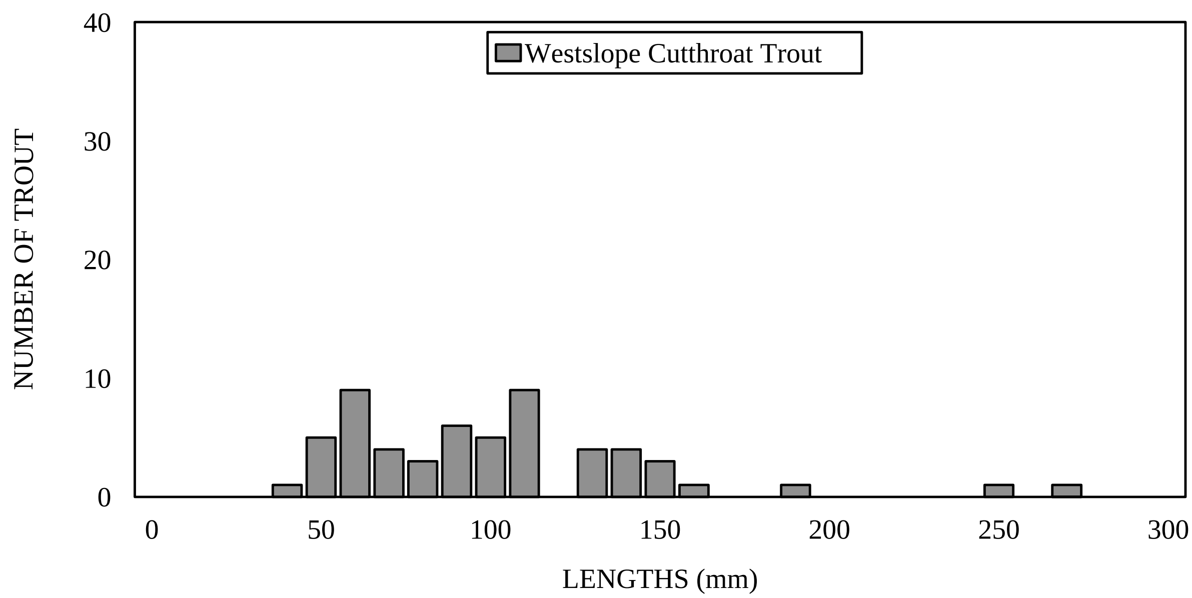


Figure 9. Species composition and length frequency of salmonids captured by electrofishing in Boulder Creek, Upper Priest River drainage, Idaho, 1998.

Table 6. Density estimates of trout and char captured by electrofishing in six tributaries in the Upper Priest River drainage, and two tributaries to Upper Priest Lake, Idaho, July 1998.

Stream	Site #	Area (m^2)	Trout species present	Length range (mm)	Number of fry captured	Number of trout > 60 mm			Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
						Pass 1	Pass 2	Pass 3			
Boulder Cr.	2-2	232	Cutthroat	60-140	0	6	5	3	17	14-28	7.3
	2-3	191	Cutthroat	59-150	1	7	0	--	7	7-8	3.7
	3-1	148	Cutthroat	87-161	0	6	2	--	8	8-10	5.4
Muskegon Cr.	1-2	149	Cutthroat	89-164	0	13	0	--	13	13-14	8.7
Jackson Cr.	1-1	160	Cutthroat	67-169	0	9	3	--	12	12-14	7.5
Hughes Fork	3-2	360	Cutthroat	51-150	6	7	4	--	12	11-18	3.3
			Bull trout	50-131	1	4	1	--	5	5-6	1.4
			Brook tr	57-130	2	1	1	--	--	--	--
Cedar Cr.	2-1	330	Cutthroat	64-212	0	38	19	--	72	57-96	21.8
			Bull trout	67-138	0	1	1	--	--	--	--
Malcom Cr.	1-1	260	Cutthroat	48-219	1	4	4	2	12	10-21	4.6
			Bull trout	90-130	0	4	5	2	14	11-26	5.4
Trapper Cr.	1-4	1,199	Cutthroat	34-234	28	21	11	--	40	32-58	3.3
			Bull trout	93-119	0	17	9	--	32	26-47	2.7
			Brook tr	220	0	1	0	--	1	1-2	0.08
	1-9	475	Cutthroat	45-182	6	37	13	--	55	50-64	11.6
East Fork Trapper Cr.	1-1	205	Cutthroat	72-201	0	20	10	--	36	30-50	17.6

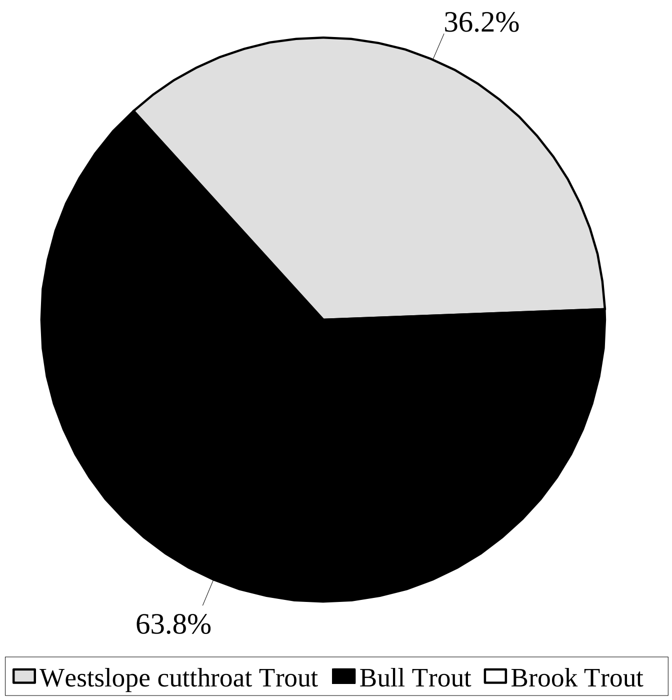
Table 7. Comparison of trout and char density estimates in selected tributaries of the Upper Priest River drainage, Idaho, 1984 and 1998. Values in parentheses represent 95% confidence intervals.

	1998[a]			1984[b]		
Stream	Westslope cutthroat trout	Bull trout	Brook trout	Westslope cutthroat trout	Bull trout	Brook trout
Boulder Cr.	5.4 (3.0)	0[c]	0	18.0(12.6)	1.5 (3.5)	0
Muskegon Cr.	8.9 (0.5)	0	0	19.6 (13.7)	0.3 (1.2)	0
Jackson Cr.	8.1 (0.7)	--[d]	0	10.2 (7.0)	13.5 (6.7)	0
Hughes Fork	3.2 (5.0)	1.5 (0.2)	--	7.6 (3.4)	3.1 (3.4)	0.01 (0.04)
Cedar Cr.	22.5 (7.0)	0	0	7.1 (4.0)	0	0
Malcom Cr.	4.6 (3.5)	5.4 (4.6)	0	4.5 (3.9)	1.5 (3.3)	0

[a] Estimates based on multiple pass depletion electrofishing.
[b] Estimates are mean densities of all habitat types surveyed by snorkeling (Irving 1987).
[c] 0 equals no fish captured or observed.
[d] -- equals fish captured but estimate could not be calculated.

Table 8. Percentages of westslope cutthroat trout, bull trout, and brook trout observed by snorkeling (1984) or captured by electrofishing (1998) in tributaries to Upper Priest River, Idaho, 1984 and 1998.

	Westslope cutthroat trout				Bull trout				Brook trout			
	1984		1998		1984		1998		1984		1998	
Stream	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Boulder Cr.	767	87.2	57	100.0	88	10.0	0	0	25	2.8	0	0
Gold Cr.	667	48.8	17	36.0	293	21.4	30	64.0	407	29.8	0	0
Muskegon Cr.	1,675	100.0	27	100.0	0	0	0	0	0	0	0	0
Jackson Cr.	813	45.0	40	95.0	998	55.0	2	5.0	0	0	0	0
Bench Cr.	182	15.6	15	83.0	987	84.4	3	17.0	0	0	0	0
Hughes Fork	9,691	71.4	51	58.0	3,862	28.4	19	22.0	28	0.2	18	20.0
Ruby Cr.	2,418	98.0	4	31.0	0	0	0	0	49	2.0	9	69.0
Cedar Cr.	374	100.0	191	98.0	0	0	4	2.0	0	0	0	0
Lime Cr.	3,009	93.0	40	100.0	220	6.8	0	0	8	0.3	0	0
Rock Cr.	587	94.2	17	85.0	36	5.8	0	0	0	0	3	15.0
Malcom Cr.	123	73.2	11	50.0	45	26.8	11	50.0	0	0	0	0



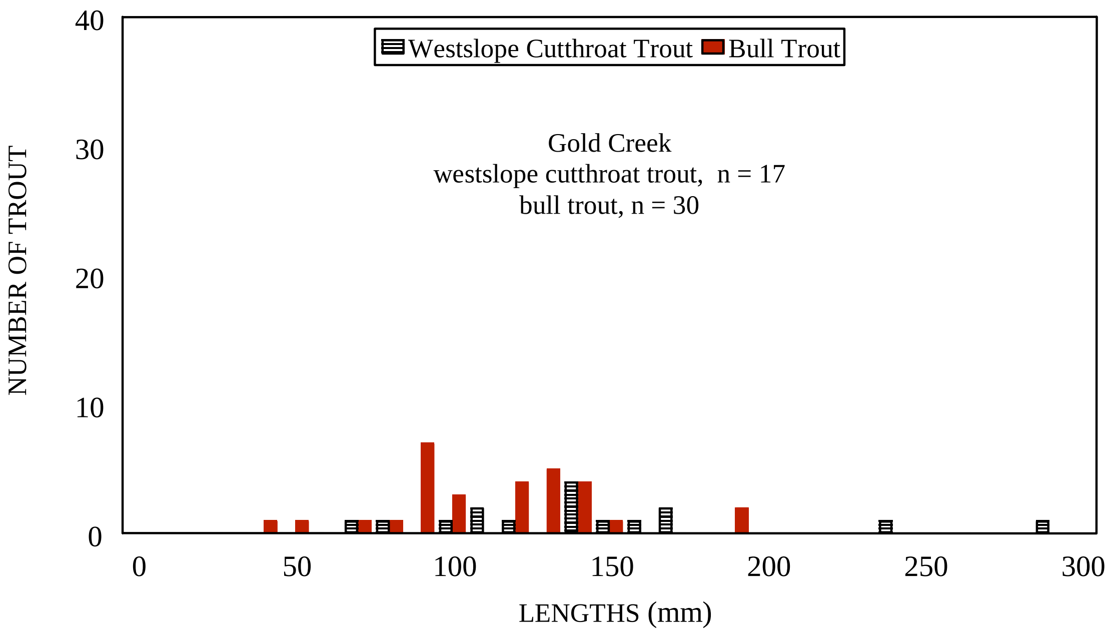
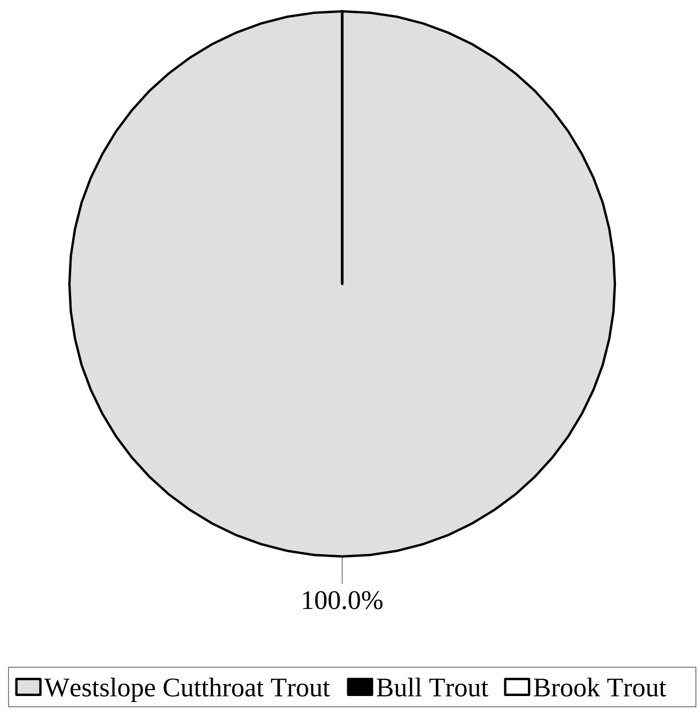


Figure 10. Species composition and length frequency of salmonids captured by electrofishing in Gold Creek, Upper Priest River drainage, Idaho, 1998.



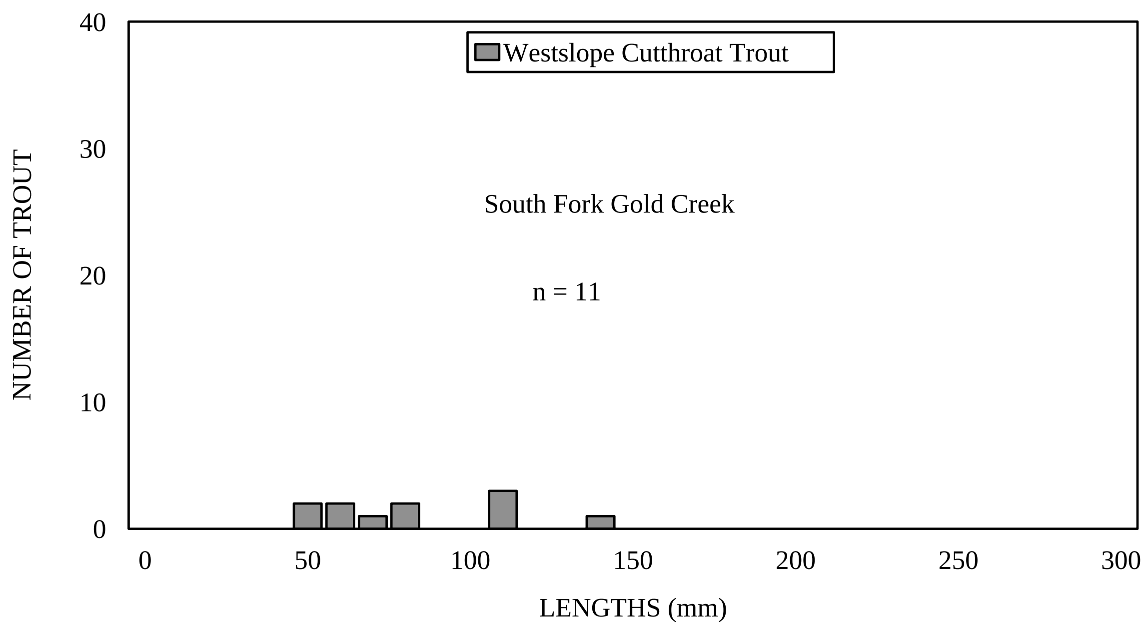
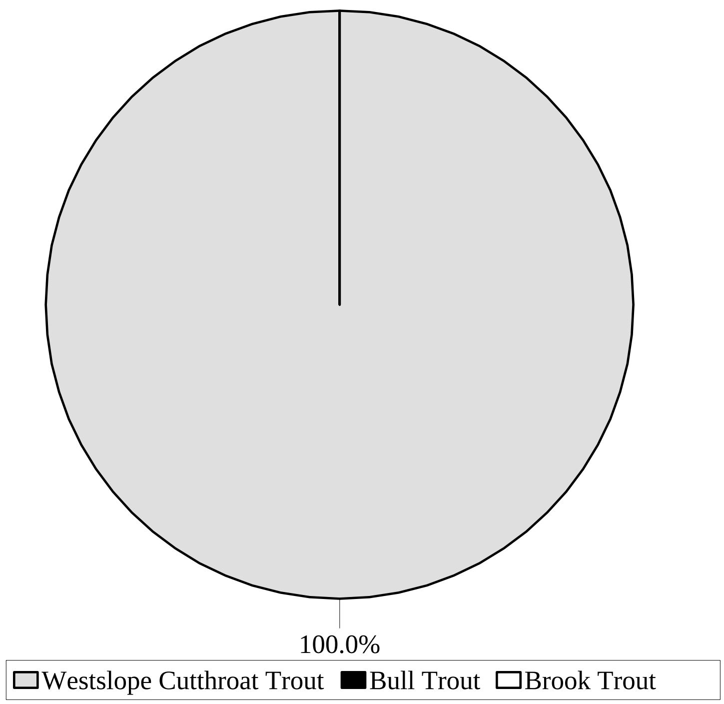


Figure 11. Species composition and length frequency of salmonids captured in South Fork Gold Creek, Upper Priest River drainage, Idaho, 1998.



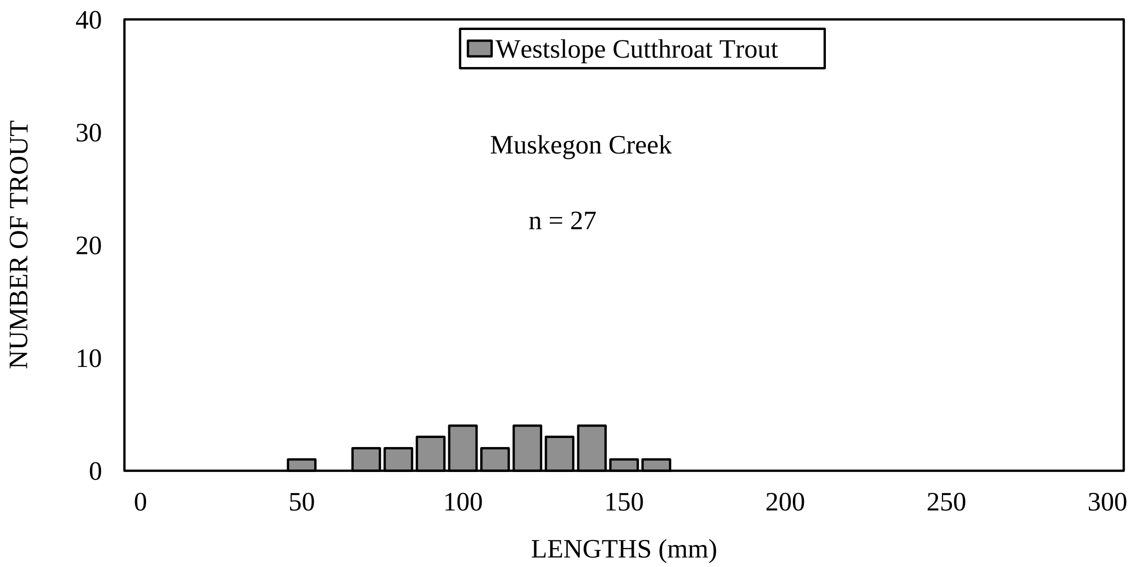


Figure 12. Species composition and length frequency of salmonids captured by electrofishing in Muskegon Creek, Upper Priest River drainage, Idaho, 1998.

culvert with a 0.6 m drop located approximately 200 m upstream from the mouth, and there is a barrier waterfall about 2.1 km upstream from the mouth (Irving 1987).

As in 1998, westslope cutthroat trout was the only species observed in Muskegon Creek in 1984 (Irving 1987). The estimated density of cutthroat observed by snorkeling in 1984 was 19.6 (∀13.7) fish/100 m^2 (Table 7).

Jackson Creek-The estimated density of cutthroat trout in Jackson Creek was 7.5 fish/100 m^2 in 1998 (Table 6). Westslope cutthroat trout comprised 95% of the salmonids captured in the five reaches surveyed in Jackson Creek and bull trout comprised 5% (Table 8). Captured westslope cutthroat trout ranged in length from 40 mm to 160 mm and the two bull trout captured were 130 mm and 140 mm (Figure 13).

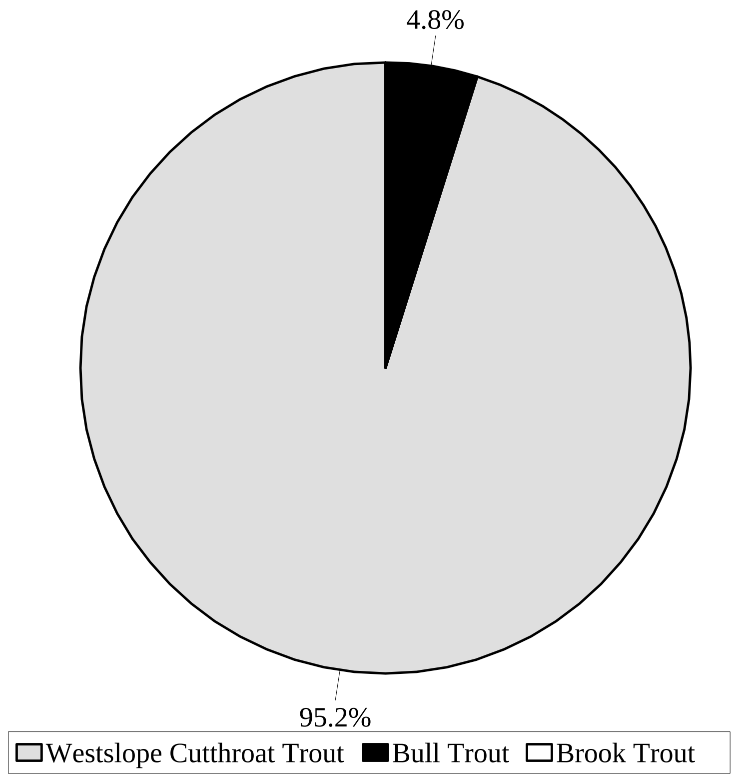
The 1998 density estimate was not much different from the estimated density of westslope cutthroat trout observed by snorkeling in 1984, (10.2 ∀7.0 fish/100 m^2; Irving 1987; Table 7). The density for bull trout in 1984 was 13.5 (∀6.7) fish/100 m^2 (Irving 1987). Although bull trout were present in 1998, not enough fish were captured to calculate an estimate. Bull trout comprised 55% of the salmonids observed by Irving in 1984, which was much higher than the 5% in 1998 (Table 8).

Bench Creek- Westslope cutthroat trout comprised 83% of the salmonids captured in the four reaches surveyed in Bench Creek and bull trout comprised 17% in 1998 (Table 8). Cutthroat trout ranged in length from 40 mm to 200 mm and the bull trout ranged from 150 mm to 180 mm (Figure 14). In 1984, bull trout comprised 84% of the salmonids observed by snorkeling and cutthroat trout 16% (Table 8).

Hughes Fork-A total of 15 stream reaches were electrofished in Hughes Fork, seven below the meadow and eight above. The estimated density of westslope cutthroat trout was 3.3 fish/100 m^2 and bull trout was 1.4 fish/100 m^2 in 1998 (Table 6). Cutthroat trout comprised 58% of the salmonids captured, bull trout were 22% and brook trout were 20% (Table 8). Brook trout seemed to be more abundant in the section below the meadow than above (Appendix G). The section from Jackson Creek to Bench Creek was snorkeled and cutthroat trout was the only salmonid observed. The estimated density was 0.13 fish/100 m^2 (Table 5). The lengths of all westslope cutthroat trout captured or observed ranged from 50 to 290 mm, bull trout ranged from 50 mm to 270 mm and brook trout ranged from 50 mm to 240 mm (Figure 15).

In 1984, the estimated density of westslope cutthroat trout was 7.6 ∀3.4 fish/100 m^2 and of bull trout was 3.1 ∀3.4 fish/100 m^2 based on snorkeling (Irving 1987; Table 7). Irving (1987) reported an estimated brook trout density of 0.01 (∀0.04) fish/100 m^2. Density estimates were lower for all three species in 1998 (Table 7). Westslope cutthroat trout comprised 58%, bull trout comprised 22%, and brook trout comprised 20% of the salmonids observed in 1998 (Table 8).

Ruby Creek-Westslope cutthroat trout and brook trout comprised 31% and 69%, respectively of the salmonids captured in three reaches surveyed in Ruby Creek in 1998 (Table 8). Cutthroat trout ranged in length from 60 mm to 100 mm and brook trout ranged from 40 mm to 150 mm (Figure 16).



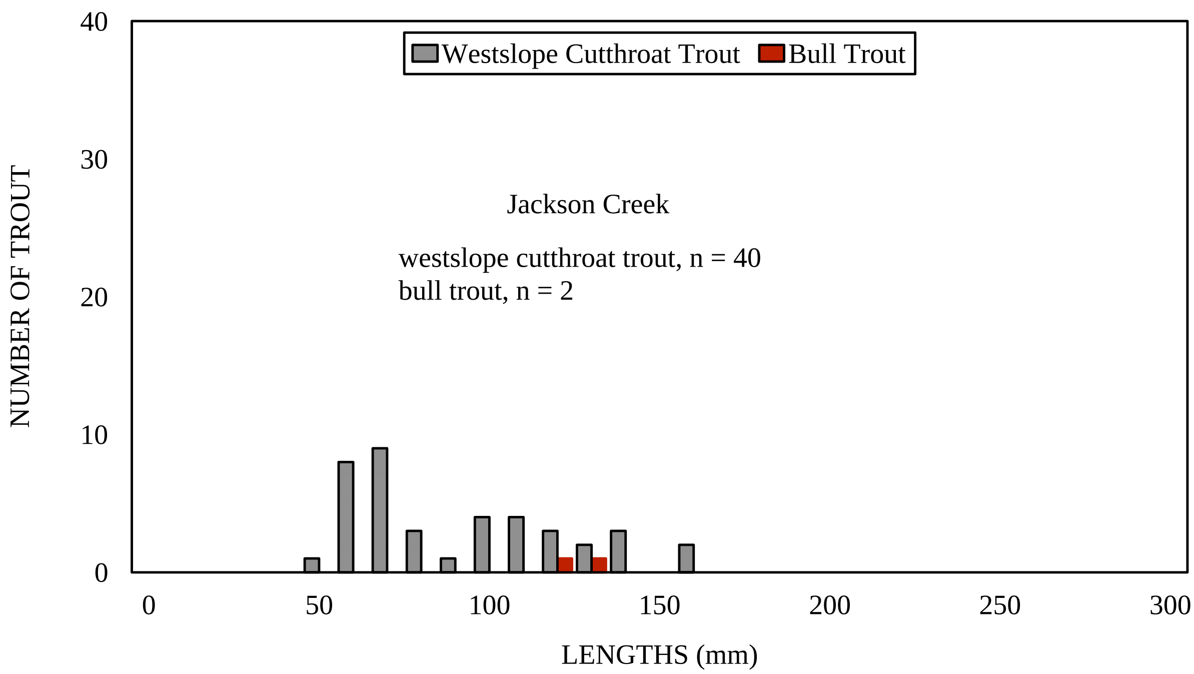
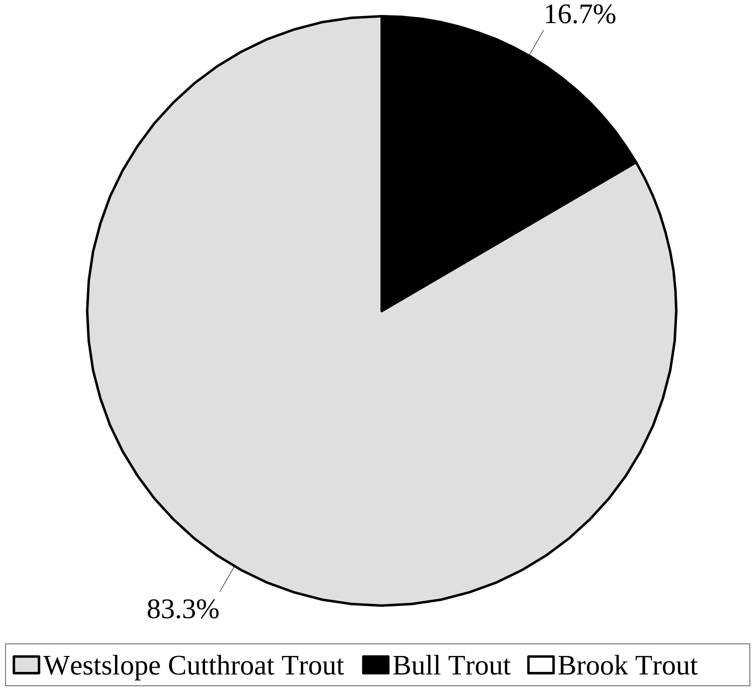


Figure 13. Species composition and length frequency of salmonids captured by electrofishing in Jackson Creek, Upper Priest River drainage, Idaho, 1998.



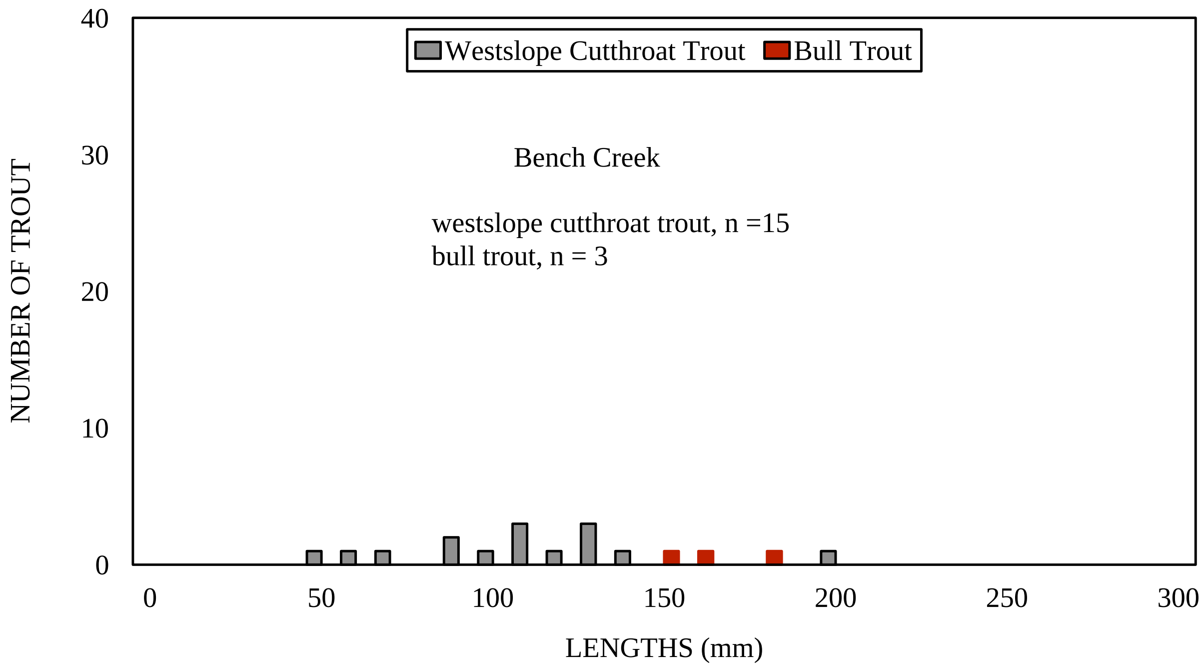
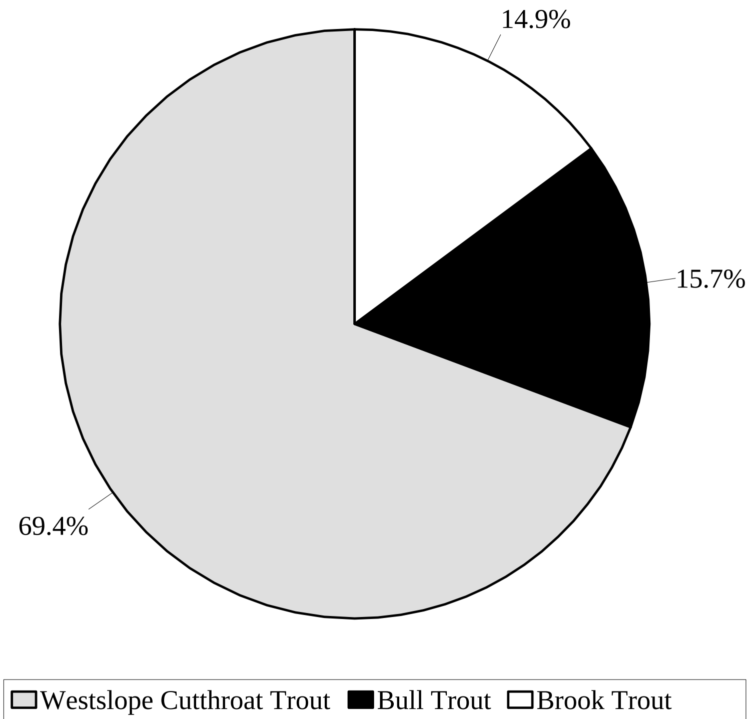


Figure 14. Species composition and length frequency of salmonids captured by electrofishing in Bench Creek, Upper Priest River drainage, Idaho, 1998.



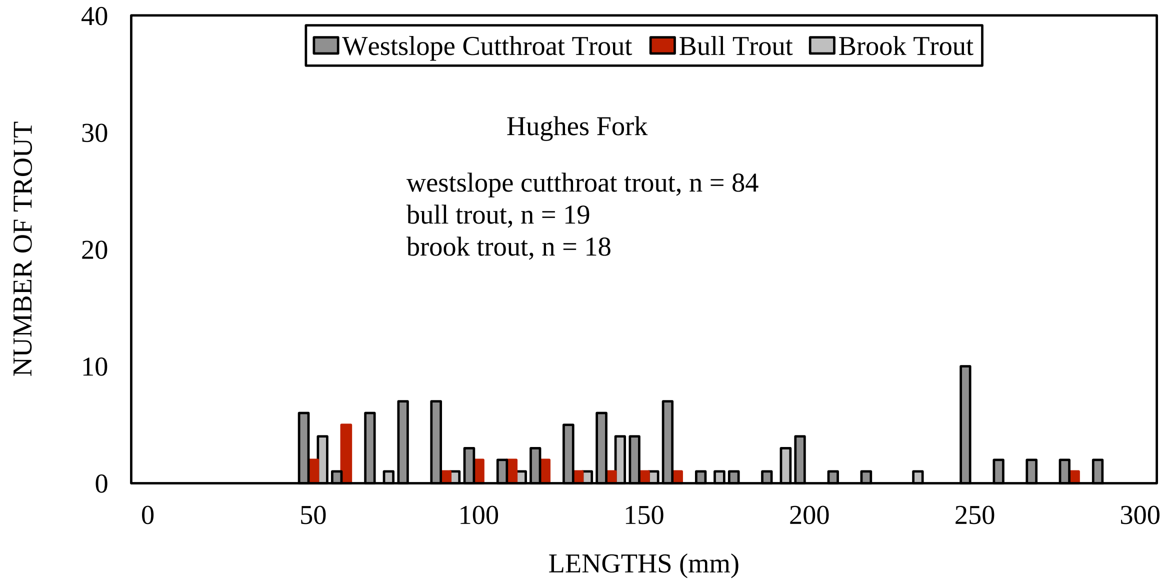
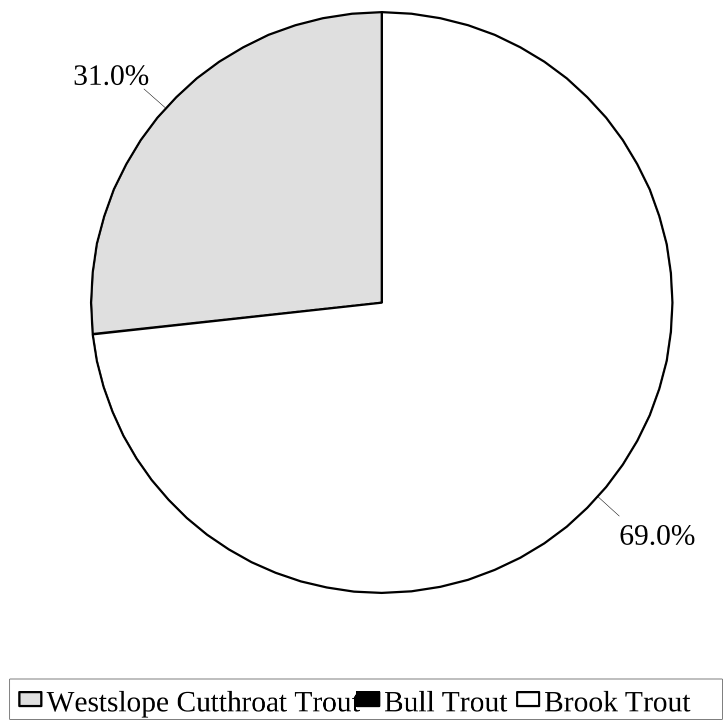


Figure 15. Species composition and length frequency of salmonids captured by electrofishing in Hughes Fork, Upper Priest River drainage, Idaho, 1998.



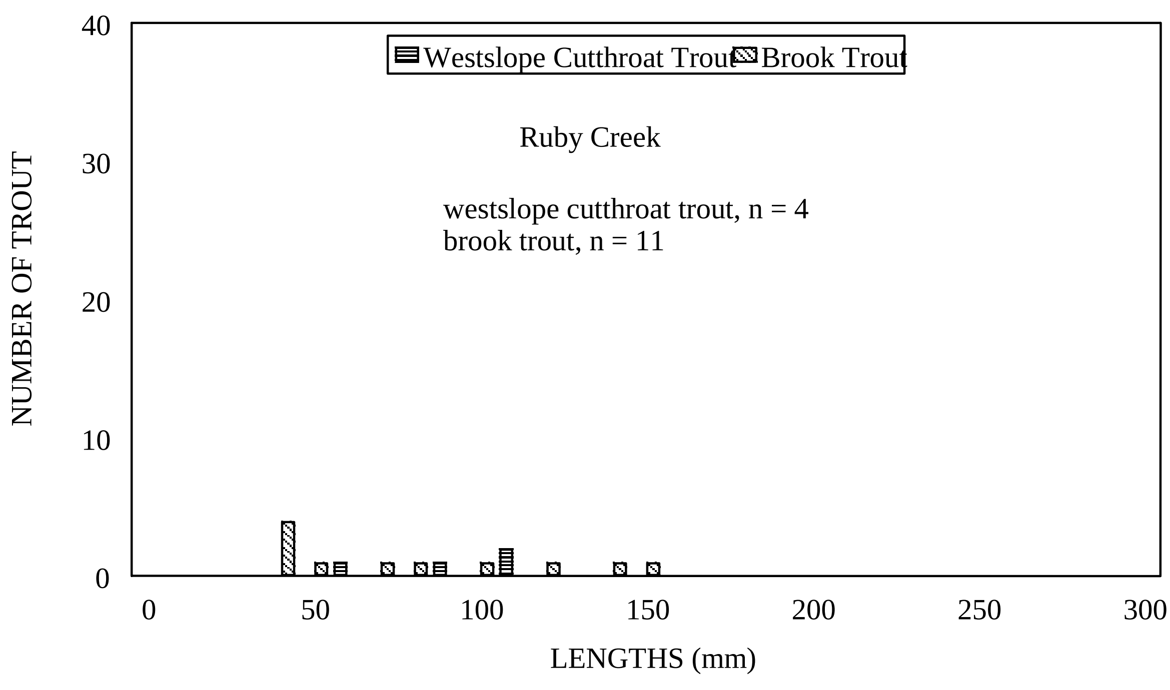


Figure 16. Species composition and length frequency of salmonids captured by electrofishing in Ruby Creek, Upper Priest River drainage, Idaho, 1998.

The brook trout abundance in Ruby Creek may have increased since 1984 when brook trout comprised only 2% of the salmonids observed by snorkeling (Table 8; Irving 1987). However, the area sampled in 1998 was located in the lower section of the stream and may not be representative of the upper reaches of the creek. Ruby Creek was targeted for brook trout removal in 1998 based on the high abundance of brook trout (see Population Management section of this report).

Cedar Creek-The density of westslope cutthroat trout estimated in Cedar Creek was 21.8 fish/100 m^2 in 1998 (Table 6). They comprised 98% of the salmonids captured and bull trout comprised 2% (Table 8) in the nine reaches surveyed. Captured cutthroat trout ranged in length from 30 mm to 230 mm and bull trout ranged from 50 mm to 130 mm (Figure 17).

The estimated density of westslope cutthroat trout in 1998 (22.5 fish/100 m^2) was much higher than the 1984 estimate of 7.1 fish/100 m^2; (Irving 1987; Table 7). However, Irving estimated density for the entire stream and the 1998 estimate was for one 30 m reach and may not be representative of the entire stream. Irving did not observe bull trout in Cedar Creek in 1984 whereas, in 1998 bull trout comprised 2% of the salmonids captured. Subsequent sampling in 1998 detected brook trout in low abundance in Cedar Creek (Jim Fredericks, Department, personal communication).

Rock Creek-Westslope cutthroat trout comprised 85% of the salmonids captured in the two reaches surveyed in Rock Creek, and brook trout comprised 15% (Table 8). The lengths of captured cutthroat trout ranged from 30 mm to 160 mm (Figure 18). In 1984, brook trout were not observed in Rock Creek (Irving 1987) indicating that brook trout have expanded their range. Sampling in 1998 was confined to the lower section of Rock Creek and it is unknown if the overall composition of brook trout is different in the upper sections of the creek.

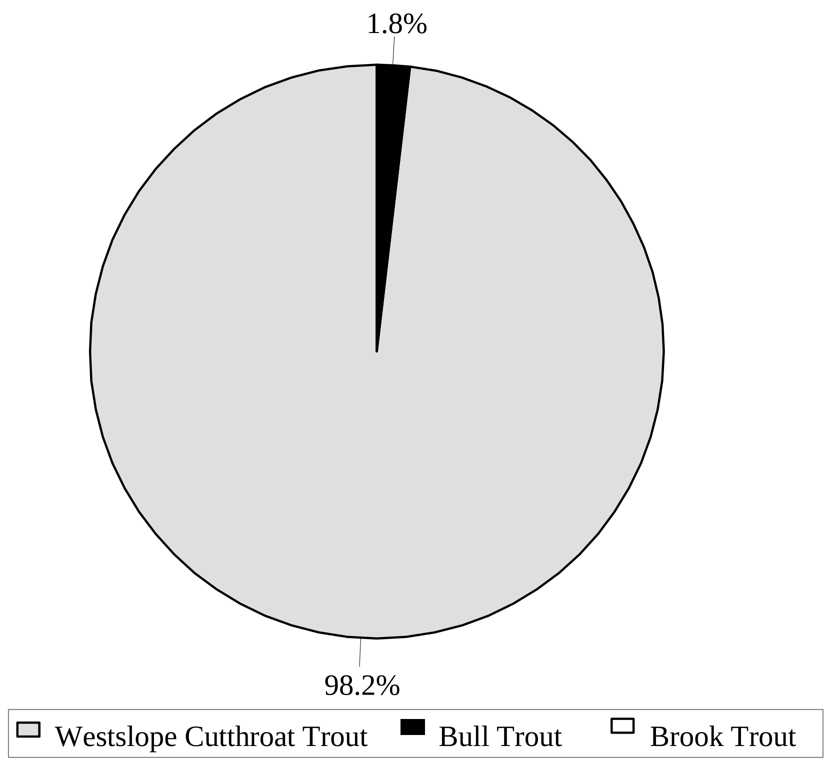
Lime Creek-Westslope cutthroat trout was the only salmonid captured in Lime Creek in 1998 and lengths ranged from 70 mm to 190 mm (Figure 19). The number of cutthroat trout captured per reach appeared to increase with elevation (Appendix G). In 1984, cutthroat trout comprised 93% of the salmonids observed in Lime Creek, bull trout 6.7% and brook trout 0.3% (Irving 1987; Table 8). Subsequent sampling in 1998 detected bull trout and brook trout in low abundance in Lime Creek (Jim Fredericks, Department, personal communication).

Malcom Creek-The estimated densities of westslope cutthroat trout and bull trout in 1998 were 4.6 fish/100 m^2 and 5.4 fish/100 m^2, respectively (Table 6). Each species comprised 50% of the fish captured (Table 8). Lengths of cutthroat trout ranged from 40 mm to 210 mm, and bull trout ranged from 90 mm to 120 mm (Figure 20). There was a waterfall barrier approximately 400 m upstream from the mouth (Irving 1987).

The 1998 density estimate of westslope cutthroat trout (4.6 ∀3.5 fish/100 m^2) was similar to the 1984 estimate (4.5 ∀3.9 fish/100 m^2; Irving 1987). Estimated bull trout density in 1984 (1.5 ∀3.3 fish/100 m^2; Irving 1987) was lower than in 1998 (5.4 ∀4.6 fish/100 m$^{2)}$ (Table 7).

Trapper Creek-The density estimate for westslope cutthroat trout, calculated for two of the nine reaches surveyed in 1998 in Trapper Creek, were 3.3 fish/100 m^2 (reach 1-4) and 11.6 fish/100 m^2 (reach

1-9) (Table 6). There was a barrier waterfall approximately 3.5 km upstream from the mouth. Reach 1-9



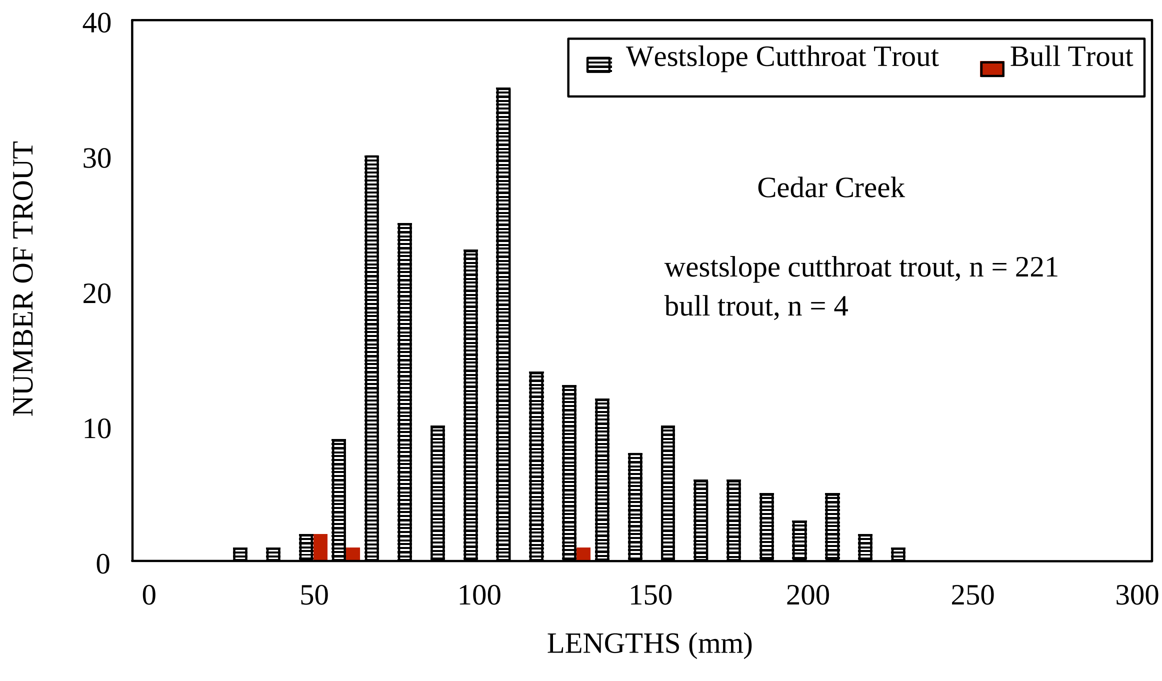
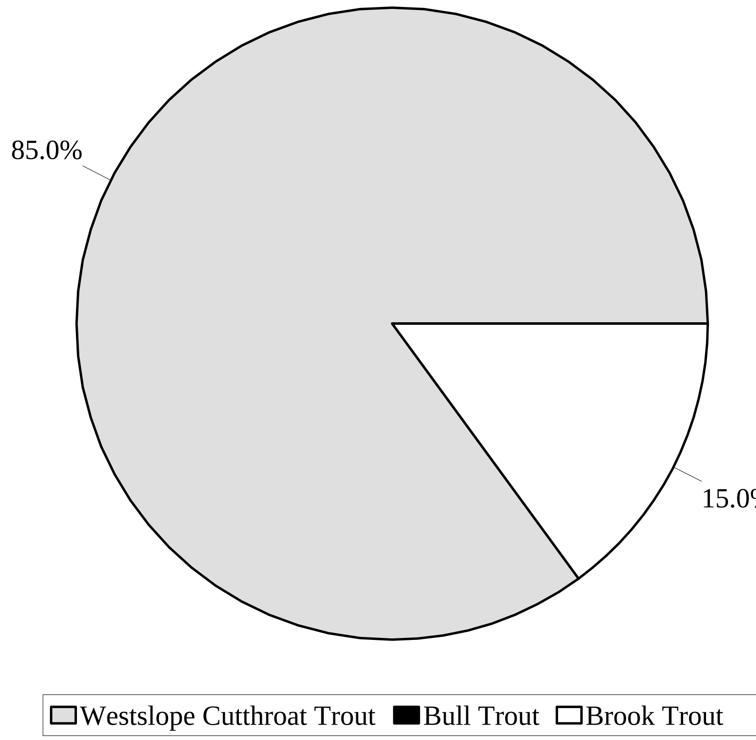


Figure 17. Species composition and length frequency of salmonids captured by electrofishing in Cedar Creek, Upper Priest River drainage, Idaho, 1998.



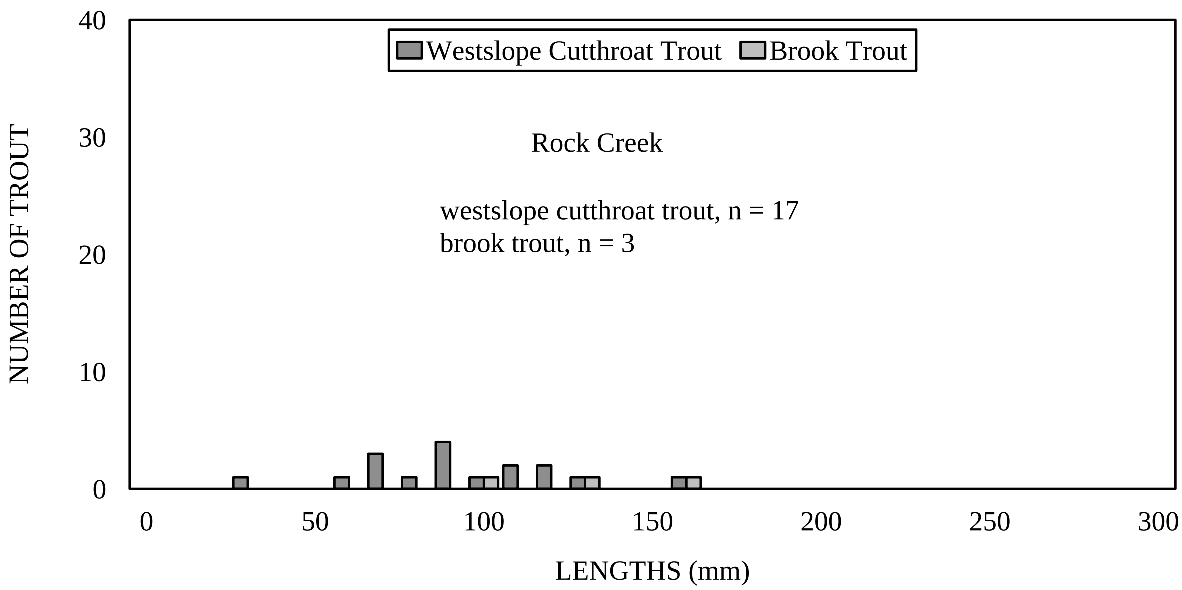
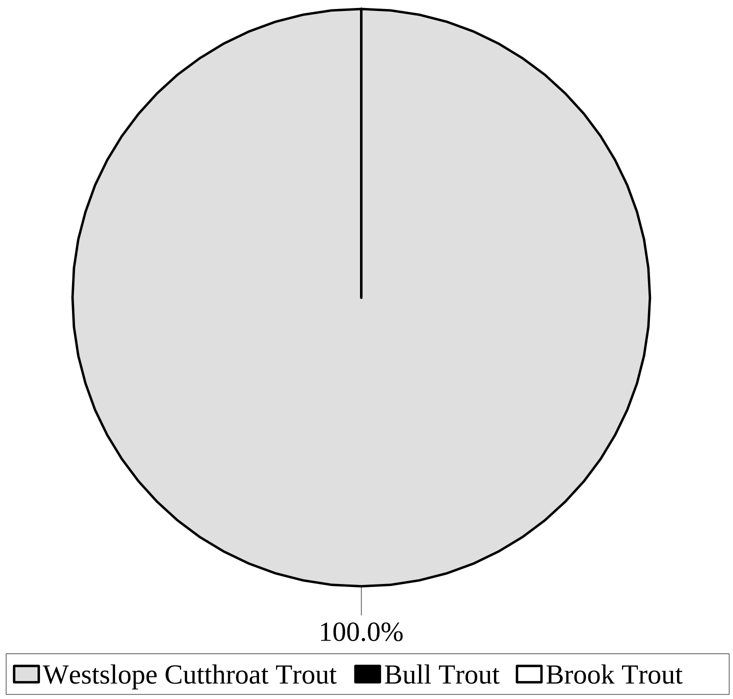


Figure 18. Species composition and length frequency of salmonids captured by electrofishing in Rock Creek, Upper Priest River drainage, Idaho, 1998.



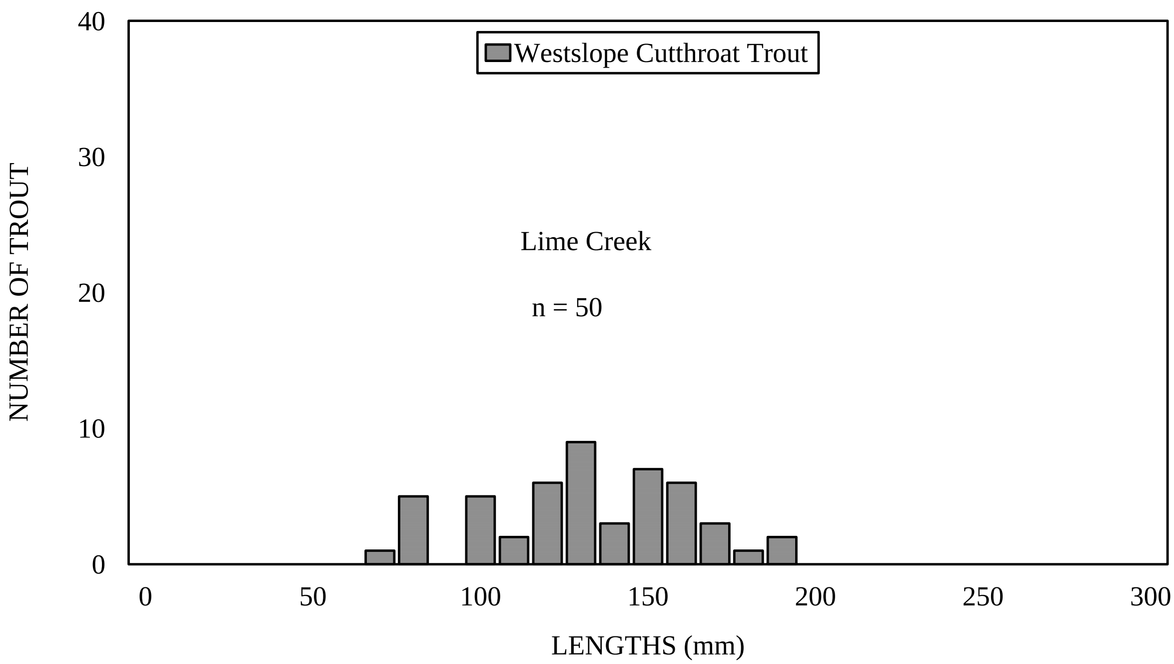
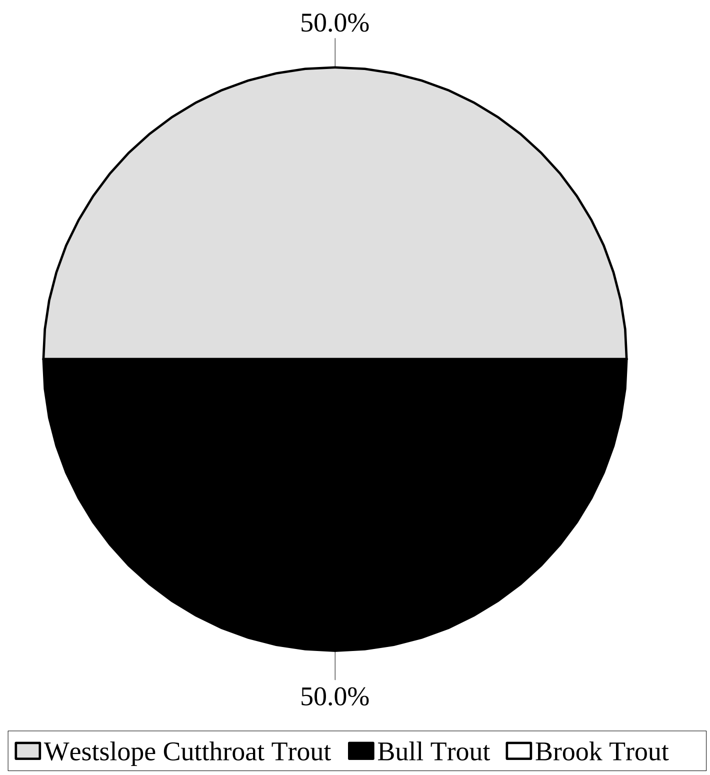


Figure 19. Species composition and length frequency of salmonids captured in Lime Creek, Upper Priest River drainage, Idaho, 1998.



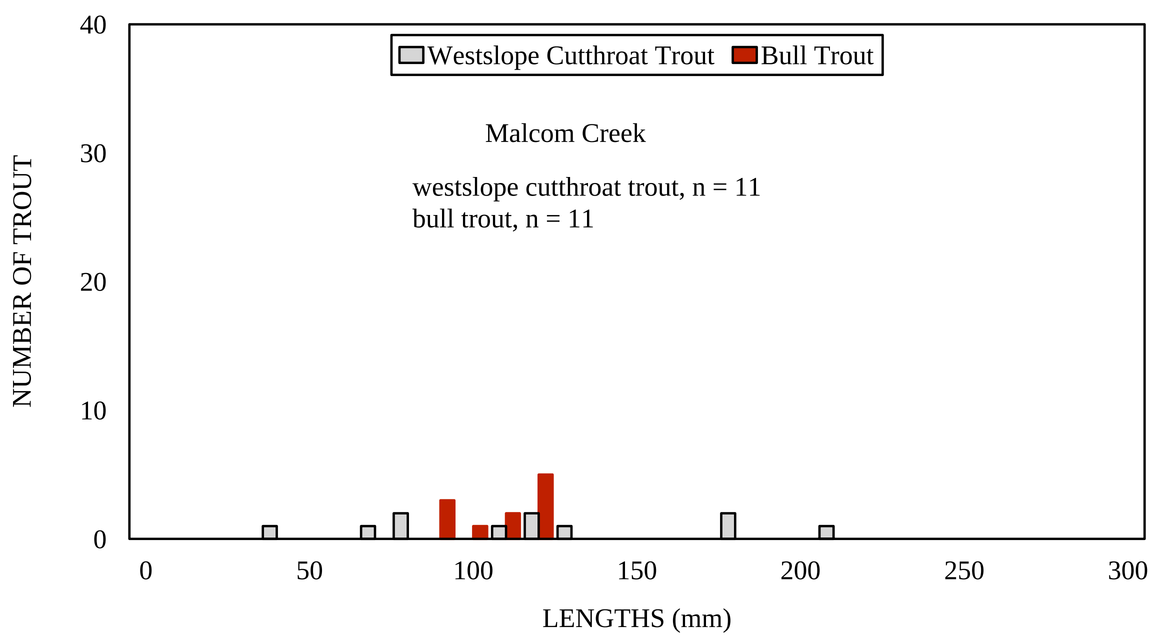


Figure 20. Species composition and length frequency of salmonids captured by electrofishing in Malcom Creek, Upper Priest River drainage, Idaho, 1998.

was the only reach surveyed above the barrier and westslope cutthroat trout was the only salmonid captured above the barrier. In reach 1-4, the estimated bull trout density was 2.7 fish/100 m^2 and the brook trout density estimate was 0.08 fish/100 m^2 (Table 6). Westslope cutthroat trout comprised 83% of the salmonids captured in Trapper Creek, bull trout comprised 16% and brook trout 1% (Figure 21). Captured trout and char ranged in length from 30 mm to 230 mm (Figure 21).

Estimated densities of westslope cutthroat trout and bull trout have not changed dramatically since 1991 (Reid et al. 1998). The cutthroat trout estimate of 11.6 ∀1.9 fish/100 m^2 in 1998 was less than the five-year mean density for the upper reach (1-9) of 17.0 ∀6.3 fish/100 m^2. In reach 1-4 below the barrier, the 1998 cutthroat trout estimate of 3.3 ∀1.5 fish/100 m^2 was slightly lower than the seven-year mean cutthroat trout density estimate of 3.6 ∀0.9. The 1998 bull trout estimate in reach 1-4, 2.7 ∀1.3 fish/100 m^2 was lower than the seven-year mean bull trout estimate of 4.5 ∀1.4. Sculpins *Cottus spp.* were captured only in the reach closest to the mouth suggesting barriers limit distribution of sculpins in Trapper Creek.

East Fork Trapper Creek -Westslope cutthroat trout density was estimated at 17.6 fish/100 m^2 (Table 6) at the upper sampling site in 1998. At all sampling sites westslope cutthroat trout comprised 98% of the salmonids captured and bull trout comprised 2% (Figure 22). Captured cutthroat trout ranged in length from 40 mm to 200 mm. The only bull trout captured was 210 mm (Figure 22) and was captured near the confluence with Trapper Creek. Estimated densities of cutthroat trout in East Fork Trapper Creek have changed little since 1991 (Reid et al. 1998). The six-year mean cutthroat trout density estimate, 15.8 ∀3.3 fish/100 m^2, does not appear much different from the 1998 estimate of 17.6 ∀7.8 fish/100 m^2.

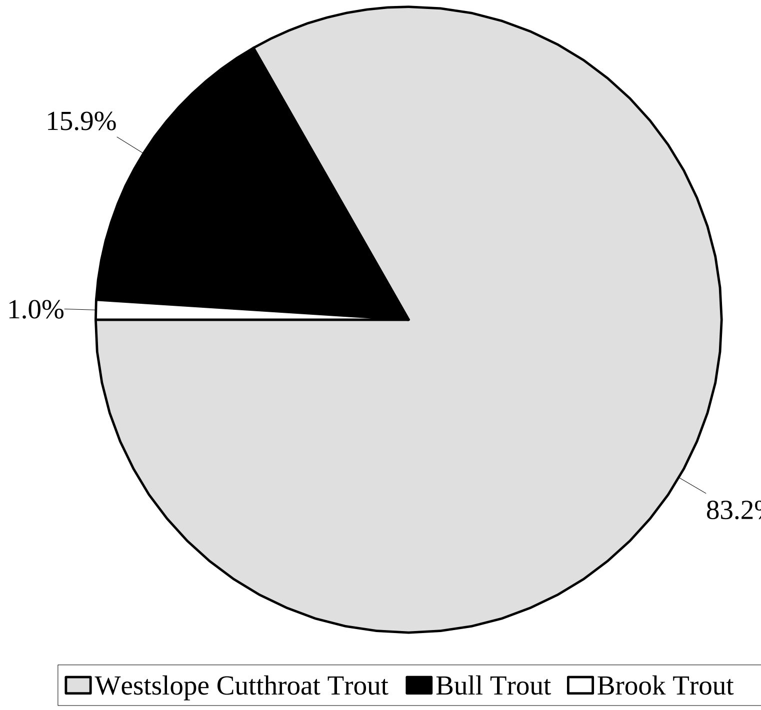
Caribou Creek-Two brook trout (91 mm and 103 mm) were the only salmonids captured in the three reaches surveyed in Caribou Creek in 1998. These reaches were located in the upper section of the creek. However, only a very small portion of the stream was surveyed. A more thorough survey may have captured westslope cutthroat trout, which were present in 1982 (Mauser and Horner 1982). Bull trout have been observed in Caribou Creek in the past.

Fish Population Assessment in Bureau of Land Management Streams

Stream Surveys

Population Distribution and Abundance-We surveyed 21 streams (57 stream reaches) in the St. Joe River (Figure 23), Kootenai River (Figure 24), South Fork Coeur d=Alene River (Figure 25), mainstem Coeur d=Alene River (Figure 25), and Coeur d=Alene Lake drainages (Figure 26) during 1998. Westslope cutthroat trout were found in all streams except Myrtle Creek and Cascade Creek, both tributaries to the Kootenai River (Table 9). Westslope cutthroat trout was the most abundant species captured in 52 of the 57 stream reaches. Caribou, Falls and Trapper creeks were the exceptions.

Westslope cutthroat trout population density estimates in the study reaches ranged from 0 to 62.9 trout/100 m^2 (Table 9). The highest density occurred in Jackass Creek followed by McFarren Gulch. Both streams are tributaries to the South Fork Coeur d'Alene River. A total of 470 westslope cutthroat trout were captured and the lengths ranged from 25 mm to 255 mm for all cutthroat trout captured



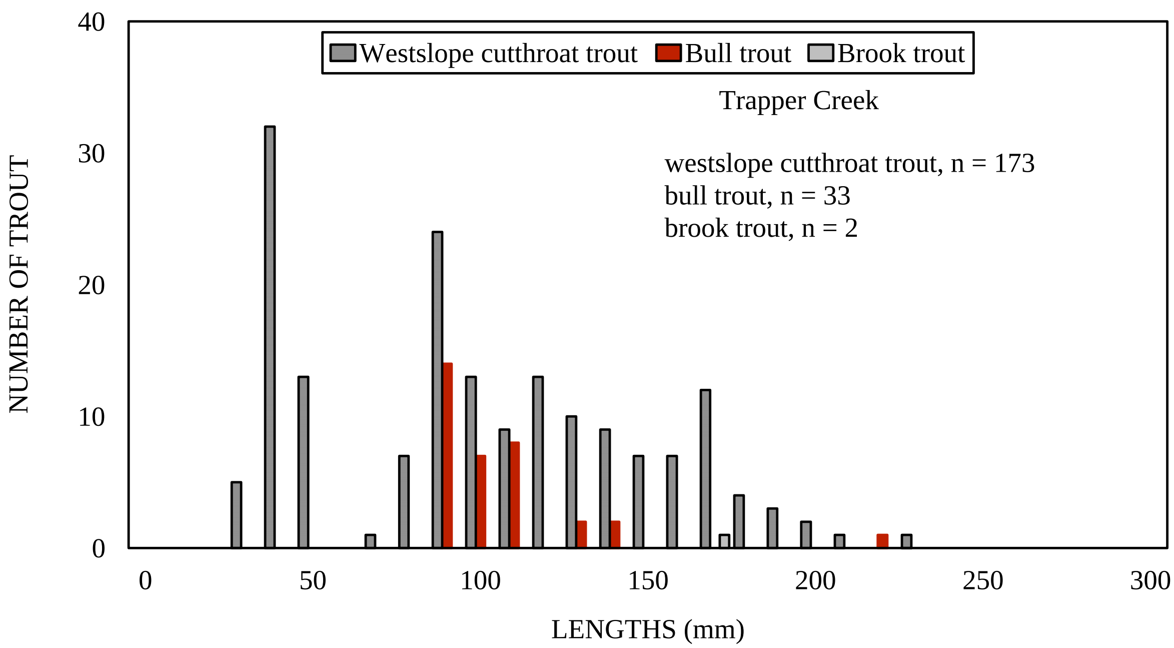
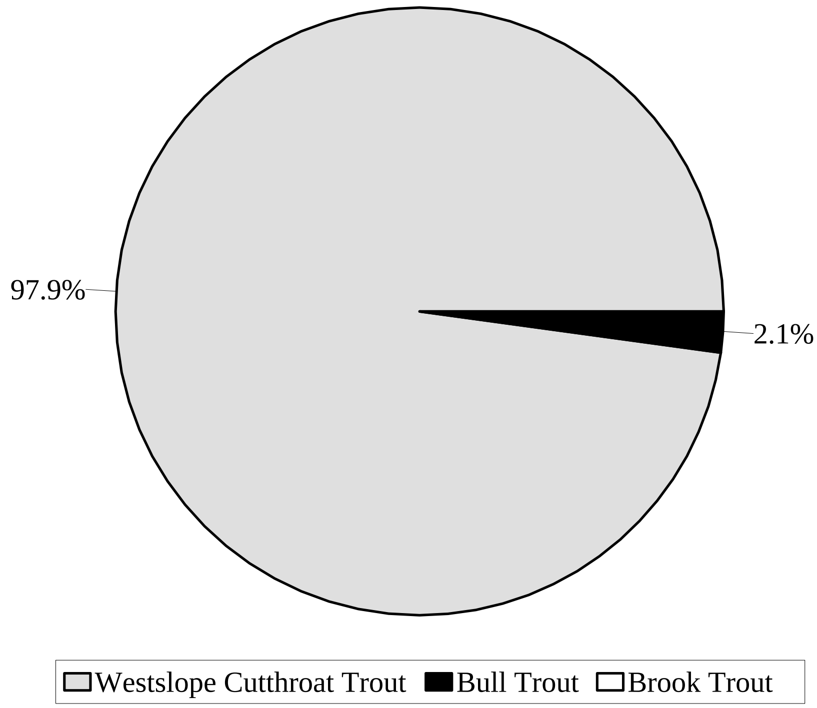


Figure 21. Species composition and length frequency of salmonids captured by electrofishing in Trapper Creek, Upper Priest Lake drainage, Idaho, 1998.



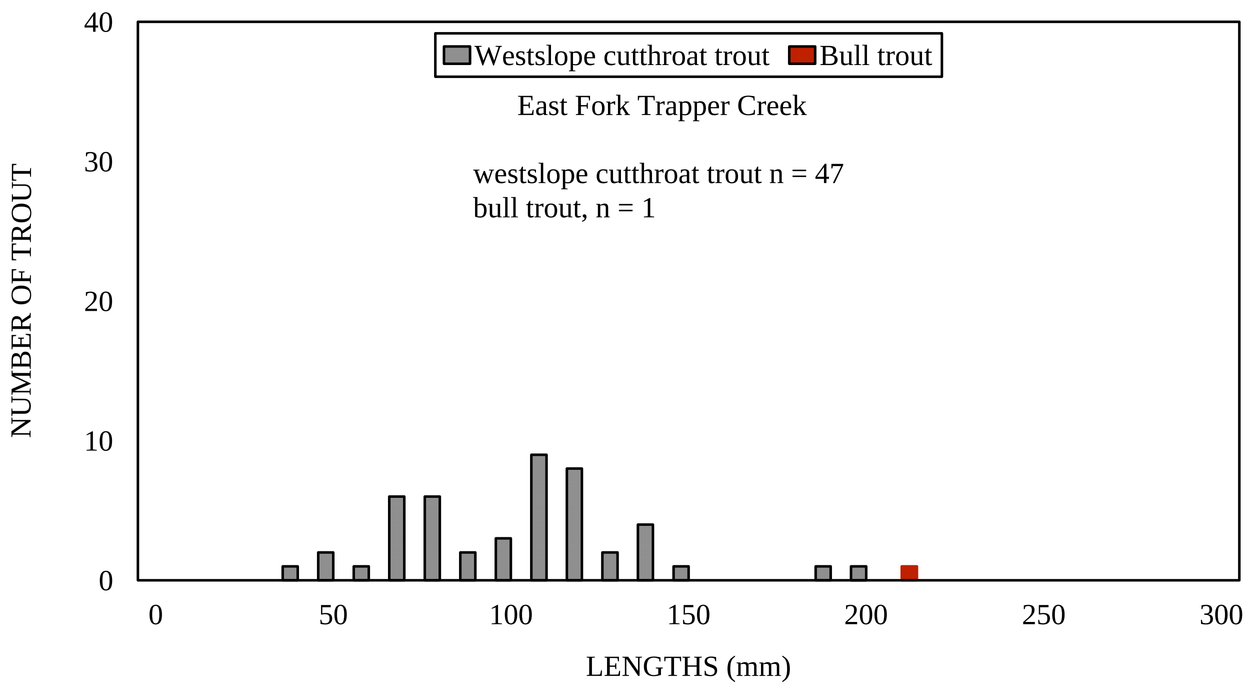


Figure 22. Species composition and length frequency of salmonid captured by electrofishing in East Fork Trapper Creek, Upper Priest Lake drainage, Idaho, 1998.

Figure 23. Insert hard copy.

Figure 24. Insert hard copy.

Figure 25. Insert hard copy.

Figure 26. Insert hard copy.

Table 9. Trout species composition (westslope cutthroat trout, brook trout, and rainbow trout, the more abundant species is listed first), population and density estimates for trout ∃60 mm (∃age 1) captured by electrofishing in selected streams in the Bureau of Land Management Emerald Resource Area, in the Idaho Panhandle, 1998.

Drainage/ Subdrainage	Stream	Site #	Trout species present	Length range (mm)	Number of fry captured	Number of trout ∃60 mm			Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
						Pass 1	Pass 2	Pass 3			
Kootenai River											
	Myrtle Creek										
		1	Brook	134-158	0	5	2	--	7	7-9	2.4
		2	Brook	31-194	2	3	3	1	7	7-10	2.3
		3	Brook	141-173	0	1	1	--	--	--	--
	Cascade Creek										
		1	Rainbow	80-134	0	1	1	--	--	--	--
		2	No trout captured		0	0	0	--	0	0	0
		3	No trout captured		0	0	0	--	0	0	0
	Caribou Creek										
			Brook	52-164	1	10	5	--	17	15-17	9.5
		1	Cutthroat	189	0	1	0	--	1	1-2	0.6
		2	Brook	109-166	0	3	2	--	--	--	--
				25-210	1	4	4	1	9	9-11	6.2
		3	Rainbow	220	0	0	0	1	--	--	--
Coeur d=Alene Lake											
	Blue Cr.	1	Cutthroat	25-130	31	8	4	1	13	13-14	13.5
St. Joe River											
	Falls Creek										
		1	Brook	35-183	1	7	1	--	8	8-9	2.7
			Brook	57-172	1	7	6	2	17	15-24	6.0
		2	Cutthroat	113-190	0	3	3	0	6	6-7	2.1
			Brook	109-238	0	15	10	6	38	31-52	13.0
		3	Cutthroat	104-222	0	6	2	1	9	9-11	3.1

Table 9. Continued.

Drainage/ Subdrainage	Stream	Site #	Species present	Length range (mm)	Number of fry captured	Number of trout ∃60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
	Black Prince Creek										
			Cutthroat	117-126	0	2	0	--	2	2-3	0.9
		1	Rainbow	102	0	0	1	--	--	--	--
		2	Cutthroat	69	0	1	0	--	1	1-2	0.6
		3	Cutthroat	80-153	0	3	0	--	3	3-4	2.5
South Fork Coeur d=Alene River											
	Red Cloud Creek										
		1	No trout captured		0	0	0	--	0	--	0
		2	No trout captured		0	0	0	--	0	--	0
		3	No trout captured		0	0	0	--	0	--	0
	Douglas Gulch										
			Cutthroat	118-197	0	6	1	--	7	7-8	5.0
		1	Brook	85	0	2	0	--	2	2-3	1.4
		2	Brook	106	0	1	0	--	1	1-2	0.9
		3	Cutthroat	35-226	2	9	9	1	20	19-24	15.8
	Trapper Creek										
			Brook	61-119	0	5	1	--	6	6-7	6.1
		1	Cutthroat	221	0	1	0	--	1	1-2	1.0
	Placer Creek										
		1	Cutthroat	46-213	1	26	8	--	36	34-42	18.1
		2	Cutthroat	35-249	4	21	14	--	53	35-94	26.1
		3	Cutthroat	67-181	0	16	5	--	22	21-26	20.7
	Experimental Draw										
		1	Cutthroat	95-158	0	7	1	--	8	8-9	13.7
		2	Cutthroat	35-210	4	8	1	--	9	9-10	13.0
		3	Cutthroat	29-145	1	5	0	--	5	5-6	5.8

Table 9. Continued.

Drainage/ Subdrainage	Stream	Site #	Species present	Length range (mm)	Number of fry captured	Number of trout ∃60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
	Cranky Gulch										
		1	Cutthroat	35-165	7	20	2	--	22	22-23	33.9
		2	No trout captured		0	0	0	--	0	0	0
		3	No trout captured		0	0	0	--	0	0	0
	Dry Gulch										
			Cutthroat	79-141	0	5	1	--	6	6-7	9.0
		1	Brook	96-115	0	2	0	--	2	2-3	3.0
		2	Cutthroat	102-123	0	1	1	--	--	--	--
		3	Cutthroat	120-149	0	2	0	--	2	2-3	2.6
	Big Creek										
			Cutthroat	63-216	1	7	4	--	12	11-18	5.5
		1	Brook	92-190	0	1	1	--	--	--	--
	West Fork Big Creek										
		1	Cutthroat	76-168	0	10	3	--	13	13-15	12.2
		2	Cutthroat	64-203	0	2	1	--	3	3-6	2.8
		3	Cutthroat	53-169	1	6	2	--	8	8-10	7.9
	McFarren Gulch										
		1		Dry reach, no fish present							
		2	Cutthroat	35-179	2	31	12	--	48	43-58	54.9
		3	Cutthroat	35-125	1	9	0	--	9	9-10	14.1
	Jackass Creek										
		1	Cutthroat	48-220	6	28	9	--	40	37-47	62.9
		2	Cutthroat	40-153	2	6	3	--	9	9-12	17.5
		3	Cutthroat	71-159	0	11	2	--	13	13-14	24.6

Table 9. Continued.

Drainage/ Subdrainage	Stream	Site #	Species present	Length range (mm)	Number of fry captured	Number of trout ∃60 mm			Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
						Pass 1	Pass 2	Pass 3			
	Boundary										
		1	Cutthroat	222	0	1	0	--	1	1-2	1.6
		2	No trout captured		0	0	0	--	0	0	0
		3	No trout captured		0	0	0	--	0	0	0
	Latour Creek										
			Cutthroat	50-135	2	0	2	1	5	3-31	1.2
		1	Brook	33-104	2	2	1	0	3	3-4	0.7
		2	Cutthroat	90-175	0	4	0	--	4	4-5	1.4
			Cutthroat	50-136	2	2	2	--	--	--	--
		3	Brook	39-151	2	5	1	--	6	6-7	1.1
	Big Baldy Creek										
		1	Cutthroat	78-121	0	3	0	--	3	3-4	3.8
		2	Cutthroat	153-253	0	1	1	--	--	--	--
		3	Cutthroat	119-255	0	1	4	1	8	8-9	3.9
	Skeel Gulch	1	Cutthroat	64-145	0	7	1	--	8	8-9	10.6
		2	No trout captured		0	0	0	--	0	0	0
		3	Cutthroat	65-254	0	15	9	3	29	27-35	42.5

(Figure 27). Fourteen rainbow trout were captured and the lengths ranged from 20 mm to 210 mm (Figure 28). Length frequency histograms for individual streams are in Appendix H.

Brook trout were found in eight of the 21 streams surveyed (Table 9). We captured a total of 113 brook trout and the lengths ranged from 30 mm to 238 mm (Figure 29). Brook trout was the only salmonid species found in Myrtle Creek. In the remainder of the streams, they coexisted with cutthroat trout. The density of brook trout was greater than cutthroat trout in four of the nine survey reaches within the seven streams (Table 9). In Caribou Creek, more brook trout and rainbow trout were captured than westslope cutthroat trout. Brook trout was the more abundant trout species captured in Falls and Trapper creeks (Table 9).

Habitat-Not all stream habitats (pool, riffle, run/glide, and pocket water) were found in each of the 57 surveyed stream reaches (Table 10). Forty stream reaches had pool habitat. The percentage of pool habitat ranged from 10% to 100%. Twenty-nine stream reaches that had pool habitat had less than 50% of the total habitat classified as pools. Eleven stream reaches had 50% or more of the stream habitat classified as pools.

Forty of the surveyed stream reaches had stream habitat classified as riffles. In these 40 reaches, the percentage for habitat classified as riffles ranged from 5% to 90% (Table 10). In 25 stream reaches, riffle habitat comprised less than 50% of the total habitat surveyed. In 15 of the surveyed stream reaches, riffle habitat comprised 50% or more of the total habitat surveyed.

Run/glide habitat was found in 32 of the surveyed stream reaches. The percentage of run/glide habitat ranged from 10% to 80% (Table 10). Eight streams reaches had 50% or more of the surveyed habitat classified as run/glide. Twenty-four stream reaches had less than 50% of the surveyed habitat classified as run/glide.

Twenty-nine stream reaches had pocket water habitat. Pocket water comprised between 5% and 100% of the total stream habitat surveyed in these 29 reaches (Table 10). Twenty stream reaches had 50% or more of the habitat classified as pocket water. Pocket water comprised less than 50% of the surveyed habitat in nine stream reaches (Table 10).

Hatchery Evaluation

Tag return rates in the Moyie River for the domestic Kamloops rainbow trout and the Colorado River rainbow trout were 7% and 3%, respectively (Table 11). Forty-nine percent of the tag returns from domestic Kamloops rainbow trout were caught in June and 40% were caught in July. Forty-seven percent of the tag returns from Colorado River rainbow trout were caught in July, 29% were caught in August, and 18% were caught in September.

The return rate for domestic Kamloops rainbow trout stocked in the St. Maries River was 7%, with 70% caught in June when the tagged fish were stocked (Table 11). In Big Creek, 8% of the tags were returned, with 70% returned in July when the tagged fish were stocked (Table 11).

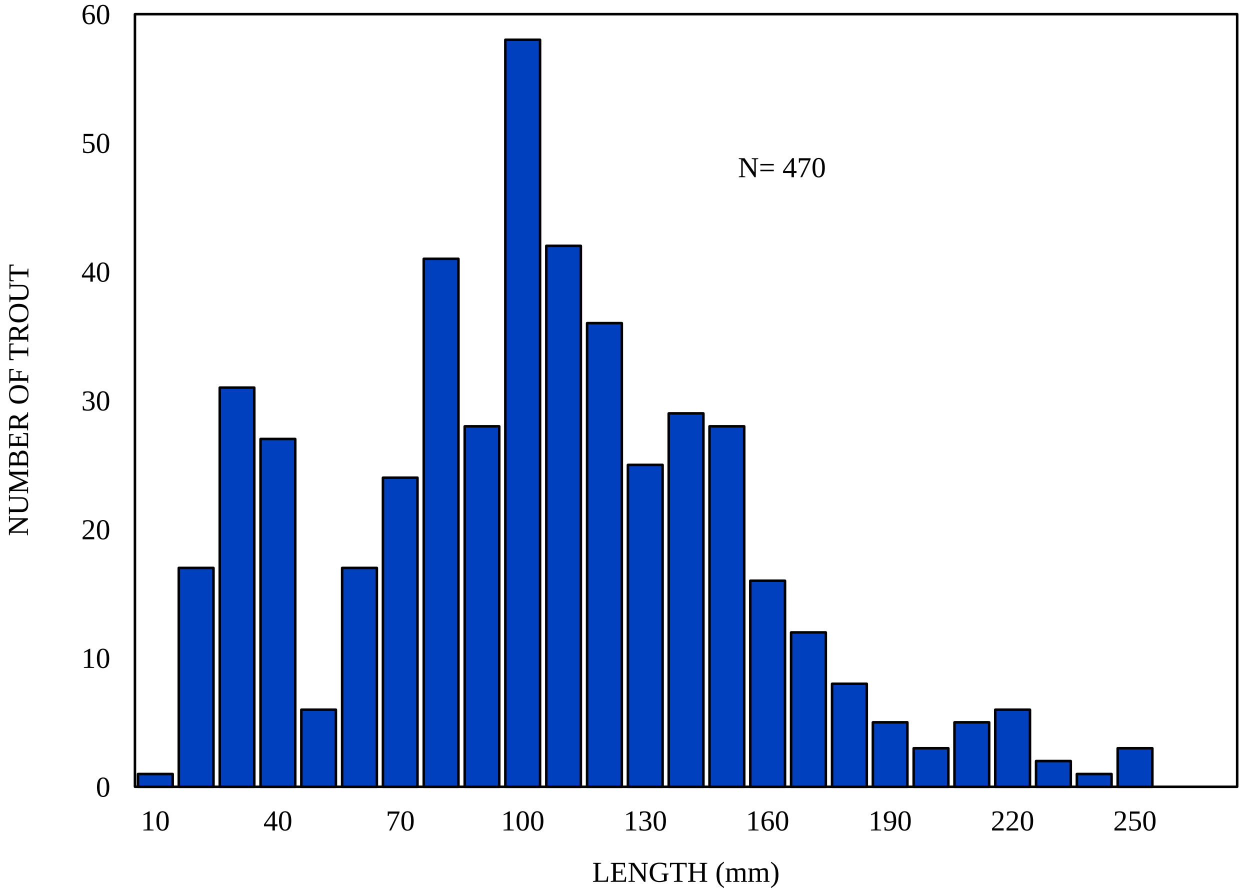


Figure 27. Length frequency histogram of westslope cutthroat trout captured by electrofishing in selected streams of northern Idaho, 1998.

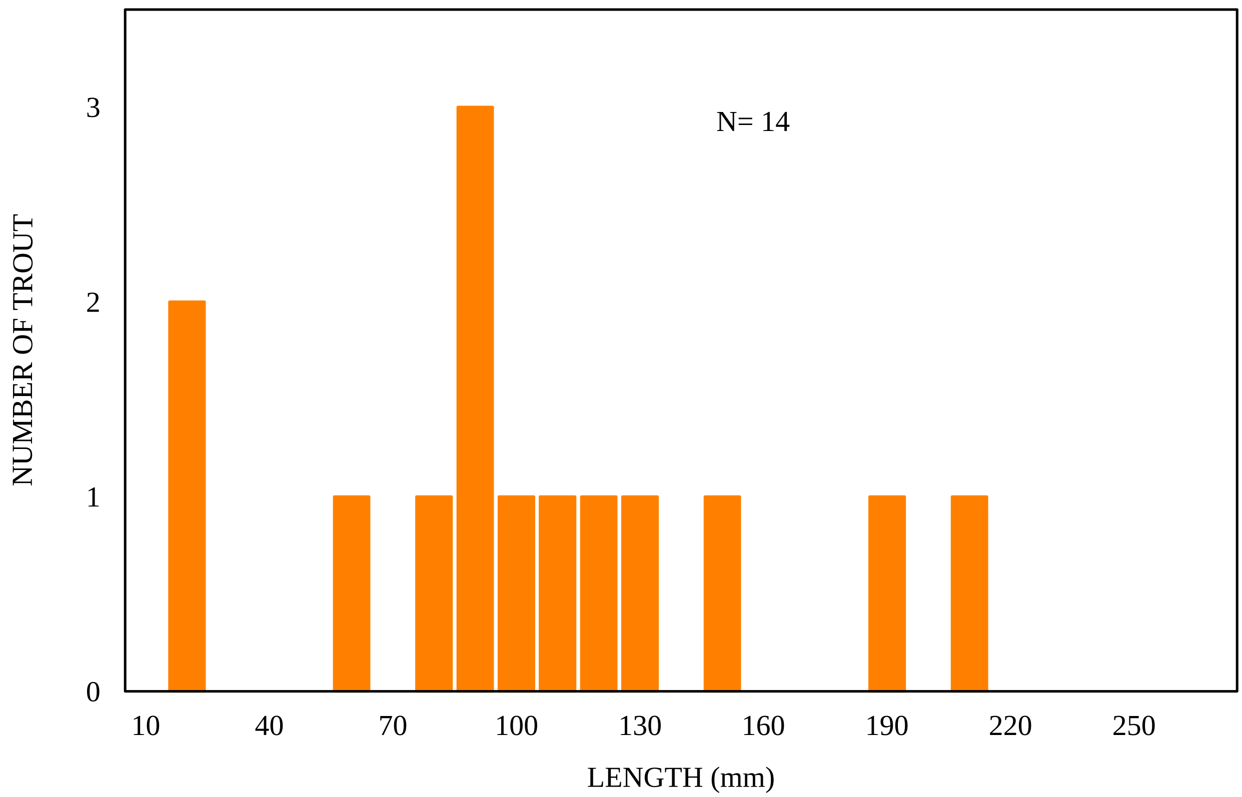


Figure 28. Length frequency of rainbow trout captured by electrofishing in selected streams in northern Idaho, 1998.

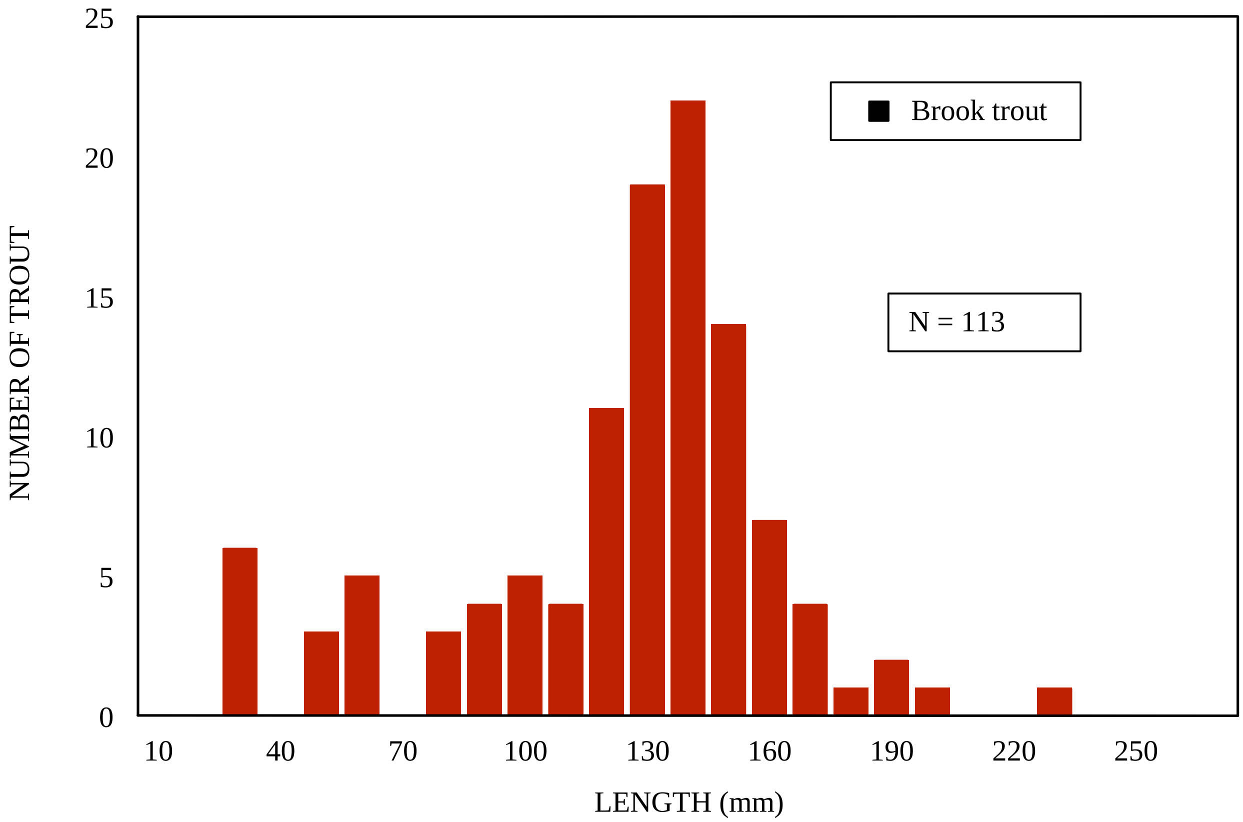


Figure 29. Length frequency of brook trout captured by electrofishing selected streams in northern Idaho, 1998.

Table 10. Summary of habitat parameters, habitat types, and substrate composition in selected north Idaho streams, 1998.

Drainage Subdrainage Stream	Reach	Length (m)	Mean width (m)	Mean depth (m)	Percentage habitat types				Percentage substrate				
					Pool	Riffle	Run/ glide	Pocket water	Sand	Gravel	Rubble	Boulder	Bedrock
Kootenai River													
Myrtle Cr.	1	50.6	5.7	0.38	10	60	--	30	18	18	23	41	--
	2	30.4	8.3	0.33	--	90	--	10	15	2	25	58	--
	3	31.5	9.6	0.32	--	20	80	--	25	16	27	32	--
Cascade Cr.	1	29.0	4.0	0.14	--	--	--	100	3	33	40	24	--
	2	19.5	3.4	0.17	--	--	--	100	29	19	30	22	--
	3	20.3	3.9	0.15	--	10	--	90	8	37	25	30	--
Caribou Cr.	1	42.7	4.2	0.21	10	90	--	--	11	57	25	7	--
	2	43.8	3.1	0.33	50	50	--	--	1	7	18	4	70
	3	25.6	5.7	0.24	--	20	80	--	--	12	32	40	16
Coeur d=Alene Lake													
Blue Cr.	1	46.0	2.1	0.08	20	5	70	5	24	21	47	8	--
	2	41.2	1.8	0.10	25	5	70	--	37	36	27	--	--
St. Joe River													
Falls Cr.	1	42.8	7.0	0.19	50	--	--	50		33	32	29	--
	2	34.0	8.4	0.19	30	50	20	--	6	27	29	38	--
	3	42.5	6.9	0.17	--	--	10	90	5	17	33	39	6
Black Prince Cr.	1	45.0	4.8	0.12	20	40	40	--	--	24	60	16	--
	2	28.3	5.4	0.25	50	20	30	--	12	30	14	44	--
	3	45.2	2.7	0.29	20	10	10	60	20	4	20	39	17

Table 10. Continued.

Drainage Subdrainage Stream	Reach	Length (m)	Mean width (m)	Mean depth (m)	Percentage habitat types: Pool	Riffle	Run/ glide	Pocket water	Percentage substrate: Sand	Gravel	Rubble	Boulder	Bedrock
Coeur d=Alene River													
Latour Cr.	1	36.3	11.9	0.21	40	20	40	--	12	33	56	--	--
Latour Cr.	2	39.1	7.2	0.24	10	40	50	--	10	16	46	37	--
	3	64.5	8.4	0.26	30	30	40	--	11	38	10	41	--
Big Baldy Cr.	1	25.0	3.1	0.19	10	80	10	--	10	28	55	7	--
	2	32.7		0.17	100	50	20	20	20	24	57	17	--
	3	44.0	4.6	0.16	30	20	40	10	7	23	62		
	1	27.1	2.8	0.16	80	20	--	--	19	25	56	--	--
	2	30.0	1.6		10	45	45	--	12	53	35	--	--
	3	27.3	2.5	0.13	30	65	--	5	16	31	22	31	--
South Fork Coeur d=Alene River													
Boulder Cr.	1	38.3	3.3	0.09	30	--	--	70	--	28	30	34	8
	2	35.8	2.5	0.11	30	--	--	70	2	20	36	--	42
	3	29.3	3.8	0.12	30	--	--	70	--	16	63	21	--
South Fork Coeur d=Alene River													
McFarren Gulch	1	DRY											
	2	38.0	2.3	0.08	--	--	--	100	--	53	31	16	--
	3	29.1	2.2	0.07	60	10	30	--	6	36	30	28	--
Jackass Cr.	1	30.3	2.1	0.08	30	60	10	--	--	7	85	8	--
	2	30.2	1.7	0.09	--	60	--	40	--	43	57	--	--
	3	25.2	2.1	0.06	60	20	20	--	--	19	73	8	--

Table 10. Continued.

					Percentage habitat types				Percentage substrate				
Drainage Subdrainage Stream	Reach	Length (m)	Mean width (m)	Mean depth (m)	Pool	Riffle	Run/ glide	Pocket water	Sand	Gravel	Rubble	Boulder	Bedrock
Placer Creek Subdrainage													
Placer Cr.	1	36.9	5.4	0.14	40	60	--	--	--	22	31	32	15
	2	41.5	4.9	0.10	--	40	60	--	2	28	67	3	--
Placer Cr.	3	39.4	2.7	0.15	30	--	30	--	--	50	38	12	--
Cranky Gulch	1	34.2	1.9	0.06	30	20	10	40	7	33	55	5	--
		27.9	1.4	0.06	--	--	--	100	--	32	41	27	--
	3	27.4	1.6	0.06	--	--	--	100	3	43	42	12	--
Experimental Draw	1	34.5	1.7	0.07	70	10	20	--	10	35	43	12	--
	2	26.6	2.6	0.10	--	--	--	100	--	30	70	--	--
	3	29.5	2.9	0.16	20	30	20	30	--	29	24	47	--
Dry Gulch	1	29.0	2.3	0.09	20	70	10	--	7	48	41	4	--
	2	31.3	1.9	0.05	10	80	10	--	--	56	44	--	--
	3	27.0	2.8	0.09	20	20	--	60	--	53	26	21	--
Big Creek Subdrainage													
Big Cr.	1	47.3	4.6	0.16	40	10	50	--	12	52	28	8	--
West Fork Big Cr.	1	26.2	4.4	0.10	60	10	30	--	2	55	26	17	--
	2	28.1	3.8	0.19	10	20	--	70	6	29	37	28	--
	3	34.5	3.3	0.16	30	--	10	60	--	48	30	9	13

Table 10. Continued.

Drainage Subdrainage Stream	Reach	Length (m)	Mean width (m)	Mean depth (m)	Percentage habitat types				Percentage substrate				
					Pool	Riffle	Run/ glide	Pocket water	Sand	Gravel	Rubble	Boulder	Bedrock
Pine Creek Subdrainage													
Red Cloud Cr.	1	30.6	1.6	0.07	--	--	--	100	--	39	50	11	--
	2	31.6	1.5	0.06	50	50	--	--	--	40	52	--	8
	3	33.7	1.4	0.11	60	40	--	--	--	20	65	15	--
Trapper Cr.	1	31.7	3.1	0.14	--	--	50	50	1	12	87	--	--
Douglas Gulch	1	35.8	3.9	0.15	--	--	30	70	4	18	74	4	--
	2	30.8	3.6	0.13	--	80	20	--	8	18	74	--	--
	3	30.1	4.2	0.12	20	--	--	80	--	42	58		--

Table 11. Tag return rates for hatchery rainbow trout stocked into the Moyie River, St. Maries River, and Big Creek (St. Joe River), Idaho, 1998

Stream	Strain	Number tagged	Number returned	Percent returned
Moyie River	Domestic Kamloops	948	63	7
Moyie River	Colorado River	955	26	3
St. Maries River	Domestic Kamloops	300	21	7
Big Creek	Domestic Kamloops	100	8	8

Bull Trout Spawning Surveys

Lake Pend Oreille Drainage

A total of 726 bull trout redds were counted in the Pend Oreille Lake drainage in 1998 and represents a 27% increase in total redds from 1997 (Table 12). There was a 37% increase in the number of redds counted in the six index streams (Table 12). The largest increases in the number of redds counted occurred in Trestle, East Fork Lightning, and Gold creeks. The 330 bull trout redds counted in Trestle was the highest count since 1983. The 15-year average (1983-1998, not including 1995, due to poor water conditions) in Trestle Creek is 247 (∀29) redds. The 64 redds counted in East Fork Lightning Creek was the highest since 1989 (Table 12). The mean number of redds counted in East Fork Lightning Creek (1983-1998, not including 1991 and 1995, due to poor water conditions) is 55 (∀20). The 120 redds counted in Gold Creek was slightly higher than the 16-year mean of 100 (∀17) redds. Using the fish/redd expansion factor of 2.2 (Bonar et al. 1997), an estimated 1,313 bull trout entered the six index stream reaches. The estimated number of bull trout that entered the 20 stream reaches surveyed in the Pend Oreille Lake drainage in 1998 was 1,597.

Priest Lake Drainage

The 45 bull trout redds counted in the Upper Priest Lake drainage in 1998 was similar to the 41 redds counted in 1996 (Table 13). In both years, the greatest number of redds were counted in the Upper Priest River between Rock Creek and the Upper Priest Falls. The number of redds counted in any of the tributaries to the Upper Priest watershed have rarely exceeded three with a few exceptions; Hughes Fork, Gold Creek and Trapper Creek (Table 13). Redd detection can be very difficult for observers in the Upper Priest watershed, where there is very little periphyton on the substrate. Thus, “cleaned” gravel associated with redd construction in the fall can not be easily used to identify redds.

St. Joe River Drainage

In 1998, ten streams were established as index streams in the upper St. Joe River drainage (Table 14). Six index streams were surveyed by Panhandle National Forest personnel, and four streams were

Table 12. Number of bull trout redds counted per stream in the Pend Oreille Lake drainage, Idaho, 1983-1998.

	Total redds counted															
Area Stream	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[g]	1997	1998
Clark Fork River	--	--	--	--	--	--	--	--	--	2	8	17	18[f]	3	7	8
Lightning Cr.	28	9	46	14	4	--	--	--	--	11	2	5	0[de]	6	0	3
East Fk Lightning Cr.	110	24	132	8	59	79	100	29	--[a]	32	27	28	3[de]	49	22	64
Savage Cr.	36	12	29	--	0	--	--	--	--	1	6	6	0[d]	0	0	0
Char Cr.	18	9	11	0	2	--	--	--	--	9	37	13	2[de]	14	1	16
Porcupine Cr.	37	52	32	1	9	--	--	--	--	4	6	1	2[d]	0	0	0
Wellington Cr.	21	18	15	7	2	--	--	--	--	9	4	9	1[de]	5	2	1
Rattle Cr.	51	32	21	10	35	--	--	--	--	10	8	0	1[d]	10	2	15
Johnson Cr.	13	33	23	36	10	4	17	33[b]	25	16	23	3	4[d]	5	27	17
Twin Cr.	7	25	5	28	0	--	--	--	--	3	4	0	5[d]	16	6	10
North Shore																
Trestle Cr.	298	272	298	147	230	236	217	274	220	134	304	276	140[d]	243	221	330
Pack River	34	37	49	25	14	--	--	--	--	65	21	22	0[de]	6	4	17
Grouse Cr.	2	108	55	13	56	24	50	48	33	17	23	18	0[d]	50	8	44

Table 12. Continued.

Area Stream	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[g]	1997	1998
	Total redds counted															
East Shore																
Granite Cr.	3	81	37	37	30	--	--	--	--	0	7	11	9[d]	47	90[h]	49
Sullivan Springs	9	8	14	--	6	--	--	--	--	0	24	31	9	15	42	10
North Gold Cr.	16	37	52	8	36	24	37	35	41	41	32	27	31	39	19	22
Gold Cr.	131	124	11	78	62	111	122	84	104	93	120	164	95	100	76	120
Total 6 index streams	570	598	671	290	453	478	543	503	423[c]	333	529	516	273	486	373	597

Area Stream	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[g]	1997	1998
	Total redds counted															
Total all streams	814	881	930	412	555	--	--	--	--	447	656	631	320	608	527	726

1983 and 1984 data reported by Pratt (1985).
1985 and 1986 data reported by Hoelscher and Bjornn (1989).
[a] Not surveyed in 1991 due to early snowfall.
[b] Upper section not surveyed, count is from Chute Creek downstream.
[c] Represents only a partial count due to early snowfall.
[d] Observation conditions impaired by high runoff.
[e] Stream counted twice, highest redd count reported.
[f] Two counts made same date, one by walking shoreline (seven redds observed) and one by snorkeling (18 redds observed).
[g] Two redds counted in Strong Creek.
[h] Three additional redds observed in Dry Gulch.

Table 13. Description of bull trout survey locations and transect locations, distance surveyed, and number of redds observed in the Priest Lake drainage, Idaho, 1992-1998.

Stream	Transect description	Distance (km)	Number of redds observed						
			1992	1993	1994	1995	1996	1997	1998
Upper Priest R.	Falls to Rock Creek	4.5	--	--	--	--	15	4	15
	Rock Cr. to Lime Cr.	1.1	--	2	1	1	2	0	3
	Lime Cr. to Snow Cr.	2.4	--	3	4	2	8	1	10
	Snow Cr. to Hughes Cr.	4.4	--	0	0	--	0	3	7
	Hughes Cr. to Upper Priest L	1.6	--	0	0	--	0	--	--
Rock Cr.	Mouth upstream to F.S. trail 308 crossing	0.5	0	0	--	--	2	1	0
Lime Cr.	Mouth upstream approximately 0.8 km	0.8	0	0	--	--	0	2	0
Cedar Cr.	Mouth upstream approximately 1.6 km	1.6	--	0	2	1	0	1	0
Ruby Cr.	Mouth upstream to barrier waterfall upstream from F.S. Road 655	2.0	0	0	--	--	--	0	0
Hughes Cr.	North end of Hughes Meadow upstream to F.S. trail 312 crossing	2.0	7	3	2	0	1	4	0
	Foot bridge on F.S. trail 311 downstream to F.S. road 622 bridge	2.4	2	0	7	1	2	0	0
	F.S. road 622 downstream to mouth	8.0	--	1	--	--	2	3	1
Bench Cr.	Mouth upstrean approximately 0.8 km	0.8	0	2	2	0	1	0	0
Jackson Cr.	Mouth upstream to F.S trail 311 crossing	1.6	4	0	0	0	0	0	0
Gold Cr.	Mouth upstream approximately 2.0 km	2.0	5	2	6	5	3	0	1
Boulder Cr.	Mouth upstream to barrier waterfall	1.6	0	0	0	--	0	0	0
Trapper Cr.	Mouth upstream to approximately 0.8 km upstream from East Fork	3.2	--	4	4	2	5	3	8
Caribou Cr.	Mouth upstream to old road crossing	1.6	--	1	0	0	0	0	0
		Totals	18	18	28	12	41	22	45

Table 14. Number of bull trout redds counted in index reaches of tributaries in the upper St. Joe River drainage, Idaho, 1992-1998.

	Number of redds[a] observed						
Stream	1992	1993	1994	1995	1996	1997	1998
St. Joe River from Heller Cr. to St. Joe Lake	10	14	3	20	14	6	0
Beaver Cr. and Bad Bear Cr.	2	2	0	0	0	0	1
Fly Cr.	--	--	--	0	0	--	2
Heller Cr.	0	0	--	0	--	1	0
Medicine Cr.	11	33	48	26	23	13	11
Mosquito Cr.	--	--	--	0	4	--	2
Red Ives Cr.	--	0	--	1	0	1	0
Sherlock Cr.	0	3	--	2	1	1	0
Simmons Cr.	--	7	6	5	1	0	1
Wisdom Cr.	1	1	4	5	1	0	4
Totals	24	60	61	59	44	22	21

[a] Only definite bull trout redd sightings are reported in this table. Bright/clean gravel areas reported as Apossible≅ bull trout redds are not included.

surveyed by Department personnel. A total of 21 bull trout redds were counted in these streams in 1998, which was similar to the 22 redds counted in 1997 (Table 14). Expanding the number of redds observed by 2.2 fish/redd, an estimated 46 bull trout entered the index stream reaches to spawn in 1998.

Little North Fork Clearwater River

Four bull trout redds were identified in the upper Little North Fork Clearwater River drainage in 1998 which was similar to the six redds counted in 1997 (Table 15). Lund Creek had two redds and one redd was observed in Little Lost Lake Creek, and one in the Little North Fork Clearwater River between Lund Creek and Lost Lake Creek.

Bull Trout and Westslope Cutthroat Trout Telemetry

Capture and Tagging Procedures

Bull Trout-We did not capture any bull trout by angling. Baited hoop nets placed near the thalweg did not capture any bull trout and were subject to movement due to debris buildup on the net, which increased resistance. Hoop nets located in slower velocity in the lateral margins of the river did not capture any bull trout, but these nets remained in place. The only bull trout captured was caught in a hoop net located between the highest and lowest velocity water. However this net moved, collapsed and killed the bull trout. Hoop nets would probably be more successful if placed in the slow moving water near the upper end of Coeur d=Alene Lake slack water. The nets should be in place prior to the appearance of bull trout in the river (April or May).

We used electrofishing to capture 20 bull trout, and implanted 19 with radio transmitters (Table 16). The fish were captured in the river between Packsaddle Campground and Marble Creek from May 12 through June 19, 1998. The majority of fish were captured during June 16 to 19, 1998. Bull trout implanted with transmitters ranged in total length from 410 mm to 770 mm and weighed from 290 g to 4,500 g (Table 16).

Two of the bull trout (C, N) appeared to have died as a result of post-surgical complications, evidenced by the presence of an abundance of crayfish *Pacifastacus spp.* near the transmitter. A third transmitter was found 22 km upstream from its release site. There was no evidence of mortality because the transmitter was not recovered until six weeks after it had stopped moving. However, it did stop moving upstream about four weeks after release, suggesting the mortality may have been due to surgical complications. One fish died of unknown causes August 14, 1998, well after the surgical scar was healed. We had one tag failure and this transmitter "disappeared" one month from release after being stationary for four weeks (poaching cannot be ruled out). The remaining fourteen transmitters were tracked throughout the study.

Westslope Cutthroat Trout-We captured 13 westslope cutthroat trout (12 by electrofishing and one by angling) in the St. Joe River between Red Ives Creek and Gold Creek from August 26 to September 16, 1998 (Table 17). Fish implanted with radio transmitters had lengths ranging from 335 mm to 420 mm and weighed between 400 g to 888 g. Five of the transmitters had been stationary since they were implanted. They are believed to be mortalities and were not tracked.

Table 15. Summary of bull trout redds counted in the upper Little North Fork Clearwater River drainage, Idaho, 1994, and 1996 to 1998.

Stream	1994[1]	1996[2]	1997[3]	1998[4]
Lund Creek	0	7	2	2
Little Lost Lake Creek	0	1	1	1
Lost Lake Creek	0	0	0	0
Little North Fork Clearwater River				
Lund Creek to Lost Lake Creek	Not surveyed	Not surveyed	3	1
Lost Lake Creek to headwaters	0	2	0	0
Total	0	10	6	4

[1] Survey dates September 16 - 22, observed 6 adult bull trout.
[2] Survey dates September 30 - October 3, 1996, no adult bull trout were observed.
[3] Survey dates September 23 - 25, 1997, observed one adult bull trout.
[4] Survey dates September 23 - 24, 1998, one adult bull trout was observed.

Table 16. Bull trout captured by electrofishing and implanted with radio tags in the St. Joe River, Idaho, 1998, including earliest date of most upstream location and date of last contact.

Fish	Length (mm)	Weight (g)	Frequency	Location tagged	Date tagged	Highest upstream location[1]	Location of last contact[2]
A	515		151.723	Avery Ranger Station	6-19-98	Avery R S 6-19-98	Spring Cr. 7-9-98 lost
B	510	1000	151.733	Avery Ranger Station	6-19-98	Medicine Cr. 8-14-98	Simmons Cr. 9-25-98 mortality
C	485	1100	151.743	Approximately 1 km below Avery	6-19-98	Packsaddle C G 7-20-98	Packsaddle C G 8-10-98 mortality
D	770	4500	151.753	Approximately 1 km above Storm Cr.	6-19-98	Medicine Cr. 8-6-98	Calder 11-17-98
E	585	1700	151.774	Approximately 2 km above Marble Cr.	6-16-98	Red Ives Cr. 8-26-98	Red Ives Cr. 8-26-98
F	720	2900	151.783	2 km blow Packsaddle Campground	6-19-98	Bean Cr. 8-26-98	Bean Cr. 8-26-98
G	618	1800	151.793 T	2 km above Marble Cr. (silk sutures)	6-10-98	Bean Cr. 8-10-98	Bean Cr. 8-26-98
H	680	3000	151.803 T	2 km below Fishhook Cr.	6-16-98	Simmons Cr. 8-18-98	Gold Cr. 9-25-98 mortality
I	575	1500	151.812 T	Storm Cr.	6-11-98	Bluff Cr. 7-30-98	Spring Cr. 8-14-98 mortality
J	585	290	151.823 T	3 km below Avery Ranger Station	6-18-98	Medicine Cr. 8-26-989	Simmons Cr. 9-3-98
K	660	3100	151.833 T	Stanley Ranch	6-18-98	Beaver Cr 7-16-98	Wahoo Cr. 9-29-98
L	410	700	151.872	3 km below Packsaddle Campground	6-16-98	Beaver Cr. 9-3-98	Indian Cr. 9-10-98 mortality
M	527	1400	151.883	Slate Cr. (silk sutures)	6-11-98	Medicine Cr. 8-18-98	Medicine Cr. 8-26-98
N	470	1000	151.892	1 km below Storm Cr.	6-17-98	Storm Cr. 6-17-98	Marble Cr. 7-3-98 mortality

Table 16. Continued.

Fish	Length (mm)	Weight (g)	Frequency	Location tagged	Date tagged	Highest upstream location[1]	Location of last contact[2]
O	441	750	151.903	1 km Slate Cr. (silk sutures)	6-11-98	Tumbledown Cr. 7-6-98	Tumbledown Cr. 8-18-98 mortality
P	464	1400	151.923	1 km below Fishhook Cr.	5-12-98	Simmons Cr. 7-30-98	Niagara Cr. 10-26-98
Q	490	1100	151.934	2 km below Slate Cr.	6-16-98	Medicine Cr. 8-10-98	Mica Cr. 11-17-98
R	570	1750	151.961	Fishhook Cr.	6-16-98	Red Ives Cr. 8-14-98	Slate Cr. 12-1-98
S	460	900	151.972	1 km below Storm Cr.	6-17-98	Wisdom Cr. 8-26-98	California Cr. 9-18-98 mortality

[1] Earliest date fish was located.
[2] Latest date fish was located.

Table 17. Westslope cutthroat trout captured by electrofishing and implanted with radio transmitters in the St. Joe River, Idaho, 1998.

Fish	Length (mm)	Weight (g)	Radio frequency	Location captured	Date tagged
A	346	400	149.320	Copper Cr.	8-26-98
B	360	440	149.340	Copper Cr.	8-26-98
C	372	460	149.360	CopperCr.	8-26-98
XX[1]	335	440	149.380	Copper Cr.	8-26-98
D	350	400	149.400	Copper Cr.	8-26-98
E	356	410	148.102	Copper Cr.	9-1-98
XX	375	400	148.113	Copper Cr.	9-1-98
F	420	888	148.122	Copper Cr.	9-1-98
XX	350	425	148.133	Simmons Cr.	9-1-98
XX	385	450	148.142	Simmons Cr.	9-1-98
G	375	450	148.153	Simmons Cr.	9-8-98
XX	360	520	148.174	Simmons Cr.	9-8-98
H	410	690	148.183	Red Ives Cr.	9-16-98

[1] XX=mortalities and not tracked.

Telemetry

Bull Trout-Sixteen of the nineteen implanted bull trout moved downstream between one to 20 km immediately after surgery, one moved upstream 1.6 km, one did not move, and one was not found for three weeks so immediate movement after surgery was not known. Upstream migration began one to three weeks after surgery. On July 3, seven fish were between Bluff Creek and Gold Creek, with the remainder downstream of Prospector Creek (Figure 30). By July 23 all fish were above Prospector Creek, and by August 6 six bull trout were located upstream of Red Ives Creek near known spawning areas (Figure 30). Aerial flights located several fish in tributaries where bull trout redds have been previously observed (Fredericks et al. 1997). All bull trout were located in known spawning tributaries or spawning areas in the St. Joe River by August 26 (Figure 30). Downstream migration began between August 26 and September 18, 1998 (Figure 30). Five bull trout (E, F, G, J, M) were not located in the tributaries or river after August 26. Five other bull trout (D, K, Q, P, and R) were tracked during the downstream migration. The last contact in the river was made on December 1, 1998 (Figure 30). Subsequent attempts to locate bull trout in the river (including the section from Coeur d=Alene Lake to St. Joe City) did not produce any fish, supporting the assumption that these bull trout are adfluvial and overwinter in Coeur d=Alene Lake. No attempts were made to locate bull trout in Coeur d=Alene Lake, as the attenuation of the radio signal in deep water makes it impractical.

Four bull trout (B, H, L, and S) apparently died after the spawning period. Three of these transmitters were retrieved up to 45 km downstream from the uppermost location and the fourth transmitter, which has not moved and is believed to be dead, was not retrieved. The minimum spawning mortality, represented by these four mortalities, was 28.6%.

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Five bull trout (G, H, I, J, K) had temperature sensitive transmitters. These transmitters were located more often during the early portion of the upstream migration. Generally, these fish were located in water of 16°C or less, with a few exceptions (Figure 31). One of these fish was located in water exceeding 20°C on several occasions (this fish died three weeks later on August 14, 1998 of unknown causes). Many of the highest temperatures were taken in the afternoon, however on two occasions 20°C water was found between 0800 and 0900 hours. The high morning water temperature may have been due to an observer error in counting and timing the number of pulses.

Westslope Cutthroat Trout-Westslope cutthroat trout remained at the release locations from August 26 to October 26, 1998 (Figure 32). Downstream migration toward overwintering areas continued from November through December 12, 1998. Cutthroat trout appeared to have reached overwintering areas by January 13, 1999 (Figure 32). Equipment breakdown prevented any tracking from December 12, 1998 until January 13, 1999. The cutthroat trout appeared to overwinter primarily in pools or deep runs in these four areas: Trout Creek to Big Creek (five fish), near Slate Creek (one fish), Bird Creek (one fish), and Simmons Creek (one fish).

DISCUSSION

Westslope Cutthroat Trout Population Trends

North Fork Coeur d=Alene River

Westslope cutthroat trout density in the catch-and-release section of the North Fork Coeur d=Alene River between 1993 to 1998 averaged 0.87 fish/100 m^2 (Figure 33). Cutthroat trout abundance in the harvest section between 1993-1998 averaged 0.37 fish/100 m^2 (Figure 33). Catch-and-release regulations went into effect in 1985 on the North Fork Coeur d=Alene River from Yellowdog Creek upstream (Figure 1). The number of westslope cutthroat trout counted per transect increased five-fold between 1981 and 1987 (Table 18). The number of westslope cutthroat trout counted in the catch-and-release transects between Yellowdog Creek to Teepee Creek averaged 24.9 fish/transect over the nine-year period 1987-1988, 1991, 1993-1998 (Table 18).

Harvest of westslope cutthroat trout was also restricted in the river below Yellowdog Creek in 1988. Allowable harvest changed from the general trout limit of six fish with no more than two over 405 mm, to one cutthroat trout >355 mm.. This regulation resulted in an increase in the number of westslope cutthroat trout counted per transect (Table 18). The number of westslope cutthroat trout counted per transect averaged 12.9 fish/transect over the eight-year period 1988, 1991, 1993-1998 (Table 18).

The changes in harvest regulations resulted in an increased abundance of westslope cutthroat trout in both the catch-and-release and harvest sections of the North Fork Coeur d=Alene River (Lewynsky 1986; Hunt and Bjornn 1995). However, this increase was less than the increase in abundance of westslope cutthroat trout in the St. Joe River when restrictive harvest regulations were applied. The noticeable difference between these two rivers is the condition of the habitat. Observations of habitat conditions in snorkeling transects in the North Fork Coeur d=Alene River indicated a change has occurred due to increased bedload deposition and loss of pool and pocket water habitat. Several snorkeling transects have been altered and two transects had to be relocated due to a large influx of gravel. A significant increase in westslope cutthroat trout abundance probably will not occur until habitat conditions in the North Fork Coeur d=Alene River improve.

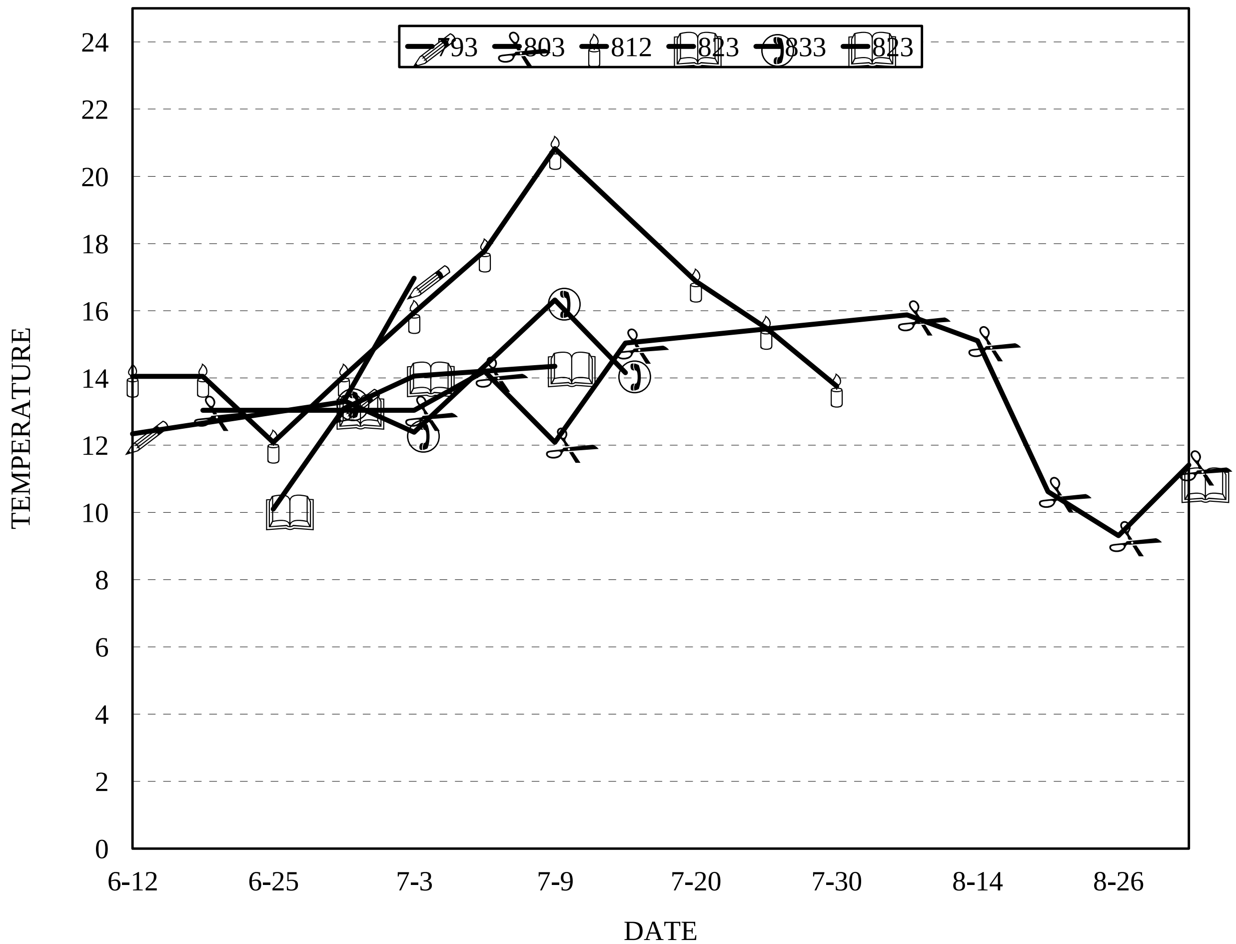

Figure 31. Temperatures of bull trout transplanted with temperature sensitive radio transmitters in the St. Joe. River, Idaho, 1998.

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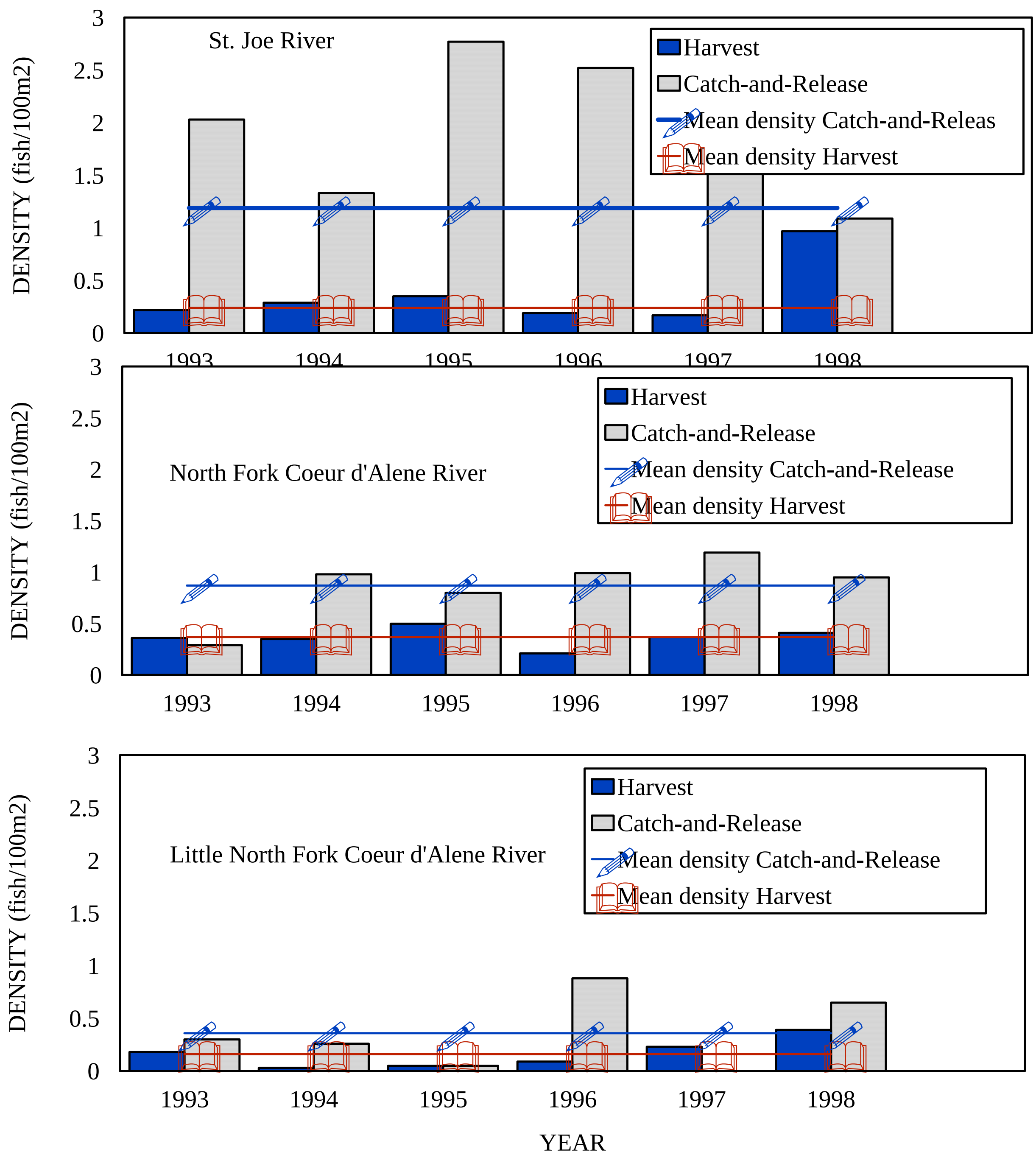

Figure 33. Density estimates of westslope cutthroat trout observed by snorkeling in the harvest and catch-and-release sections of the St. Joe River, Idaho, 1993-1998.

Table 18. Mean number of westslope cutthroat trout counted in snorkeling transects in the North Fork Coeur d'Alene River, Idaho, 1973, 1980-1981, 1987-1988, 1991, and 1993-1998.

River section	Year											
	73[1]	80[1]	81[1]	87[2]	88[3]	91[4]	93[5]	94	95	96	97	98
Confluence of South Fork Cd'A River to Yellowdog Creek	2	1	1	--	1	8	22	15	18	10	11	18
Yellowdog to Tepee Creek	11	7	6	25	27	28	9	33	31	27	31	12
Tepee Creek to Jordan Creek	6[6]	6[6]	6[6]	16	3	2	3	12	4	16	16	17
Tepee Creek Mouth to Independence Creek	0	2	4	2	1	3	3	2	1	<1	10	12
Confluence of South Fork Cd'A River to Jordan Creek (including Tepee Creek)	5	3	3	--	10	9	14	16	15	13	16	15

[1] Average value for July, August and September sampling
[2] August sampling
[3] July 20-24 sampling
[4] August sampling
[5] July 18 - August 4 sampling
[6] Fish per transect calculated for Tepee Creek to Cow Creek

Little North Fork Coeur d=Alene River

The number of westslope cutthroat trout counted per transect in the harvest section of the Little North Fork Coeur d>Alene River averaged 2.6 fish/transect for an eight-year (1988, 1991, 1993-1998) period (Table 19). In the catch-and-release section of the Little North Fork Coeur d=Alene River, the number of westslope cutthroat trout averaged 3.0 fish/transect for an eight-year (1988, 1991, 1993-1998) period (Table 19). The densities of westslope cutthroat trout in the catch-and-release and harvest sections averaged 0.36 fish/100 m^2 and 0.16 fish/100 m^2 over a six-year period, respectively (Figure 33). We have not counted any westslope cutthroat trout over 300 mm in any of the snorkeling transects in four of the last five years (Figure 34).

The wide fluctuations in the number of westslope cutthroat trout counted per transect in the Little North Fork Coeur d=Alene River is typical of a low population abundance (Rieman and McIntyre 1995). Any increase in population abundance created by harvest regulations (implemented in 1985) appeared to have been masked by other variables (Table 19). Habitat is probably the leading factor affecting westslope cutthroat trout abundance in the Little North Fork Coeur d=Alene River. Bedload movement and deposition in the Little North Fork Coeur d=Alene River is high (Sheridan 1992). In 1996, a portion of the river flowed subsurface near Owl Creek due to bedload deposition. Westslope cutthroat trout abundance probably will not increase significantly until habitat has improved.

St. Joe River

The density of westslope cutthroat trout estimated by snorkeling in the catch-and-release section of the St. Joe River was slightly lower in 1998 (1.49 ∀0.45) than in 1997 (1.96 ∀0.7; Figure 33). The difference may be related to the high water temperature (afternoon water temperatures ranged from 18^oC to 20^oC). The density in 1998 was similar to the density in 1994, which was another year of high water temperatures (Figure 33). The higher water temperatures may have caused the westslope cutthroat trout to seek cooler water. The 1998 mean density in the catch-and-release section was higher than the six-year (1993 to 1998) average of 1.19 (∀0.53) fish/100 m^2 (Table 20). The density estimates during this period ranged from a high of 2.77 fish/100 m^2 to a low of 1.09 fish/100 m^2 (Figure 33).

The density of all westslope cutthroat trout estimated by snorkeling in the harvest section of the St. Joe River was more than three times greater in 1998 than in 1997 (Figure 33). The 1998 density estimate was almost four times larger than the 1993 to 1997 average of 0.24 fish/100 m^2. The reason for the large increase in abundance in 1998 in the harvest section of the St. Joe River is unclear.

The density of westslope cutthroat trout >300 mm estimated by snorkeling in the catch-and-release section was slightly lower in 1998 (0.11 fish/100 m^2) than in 1997 (0.15 fish/100 m^2) and both years were about four times lower than the 1996 density (Figure 34). The density of westslope cutthroat trout >300 mm estimated by snorkeling in the harvest section of the St Joe River was similar in 1998 (0.007 fish/100 m^2) and in 1997 (0.005 fish/100 m^2). Both years were about six times lower than 1996 (0.04 fish/100 m^2) (Figure 34). A similar decline in density of westslope cutthroat trout >300 mm also occurred in the North Fork Coeur d=Alene River (Figure 34). The declines occurred after a major flood in the spring of 1997, suggesting the flood affected the abundance of westslope cutthroat trout >300 mm. However, a similar trend was not evident in cutthroat trout <300 mm in either river. Other factors in addition to or in conjunction with the 1997 flood may have affected abundance or distribution of cutthroat trout over 300 mm. Harvest of cutthroat trout may have added to the decline in fish >350 mm in the

Table 19. Mean number of westslope cutthroat trout counted in snorkeling transects in the Little North Fork Coeur d'Alene River, Idaho, for 1973, 1980-1981, 1988, 1991, and 1993-1998.

	Year										
River section	1973	1980	1981	1988[2]	1991[3]	1993[4]	1994	1995	1996	1997	1998
Mouth to Horse Heaven (7&8)	5.6[1]	5.9[1]	7.5[1]	2.7	3.9	3.8	2.1	0.6	3.6	2.1	7.5
Mouth to Laverne Creek (7)	--	--	0.8[5]	1.0	3.3	3.3	0.6	0.9	1.5	2.1	8.4
Laverne to Deception Cr. (8)	--	--	3.8[5,6]	7.4[6]	1.5	0.5	4.0	0	13.5	0	2.0
Deception to Horse Heaven(8)	--	--	--	--	5.3	--	4.7	0.7	2.7	0	8.7

[1] Average value for July, August and September sampling.
[2] July 20 sampling.
[3] August 21-25 sampling.
[4] July 29 sampling.
[5] Average value for 1980-1981.
[6] Densities from transects from Laverne Creek to Iron Creek.

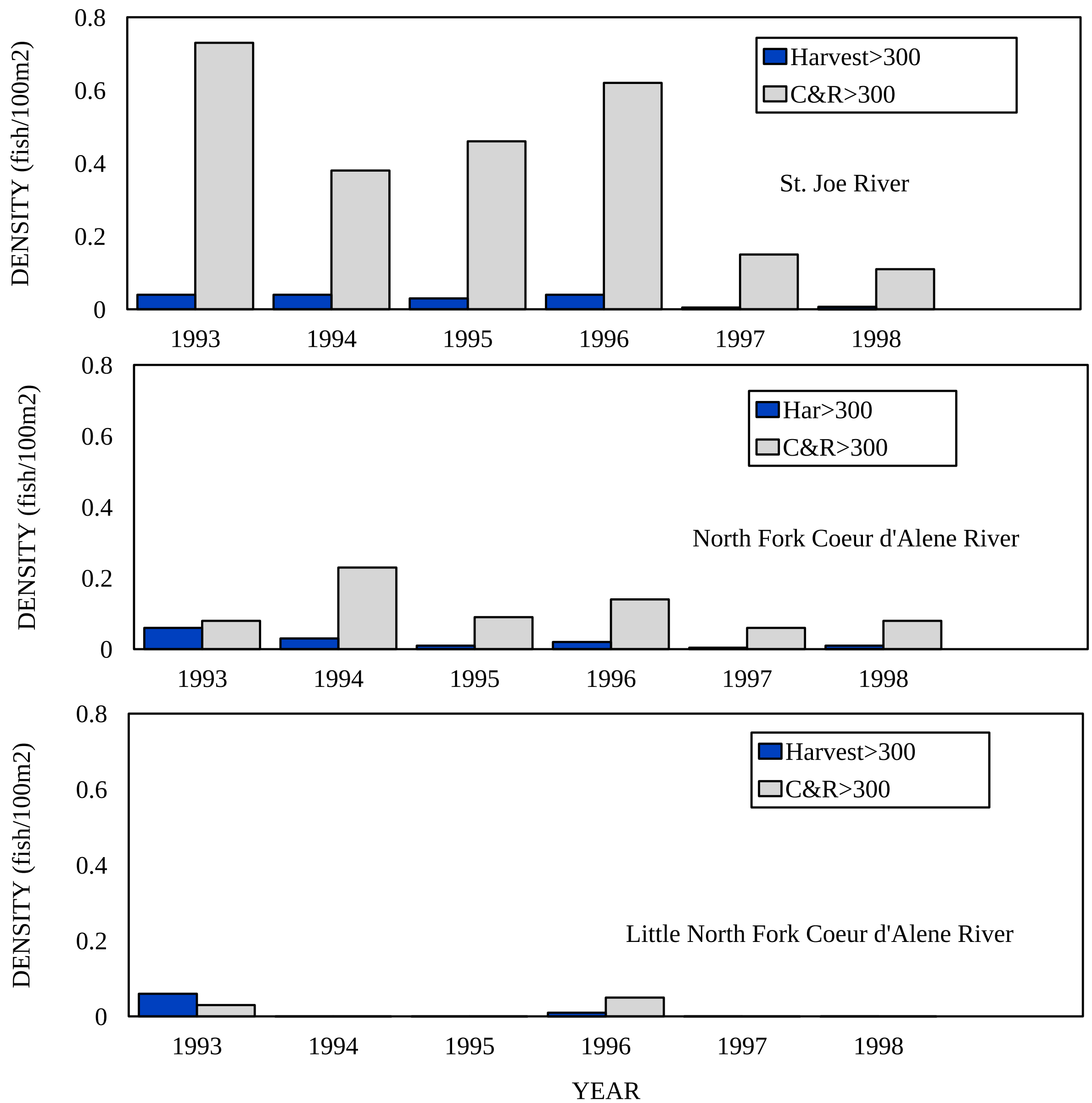

Figure 34. Density estimates of westslope cutthroat trout >300 mm observed by snorkeling in the St. Joe, North Fork, and Little North Fork of the Coeur d'Alene rivers, Idaho, 1993-1998.

Table 20. Mean number of westslope cutthroat trout counted in snorkeling transects in the St. Joe River, Idaho, 1969-1977, 1979-1980, 1982, 1990, and 1993-1998.

	Year													
Stream section	1974	1975	1976	1977	1979	1980	1982	1990	1993	1994	1995	1996	1997	1998
Prospector to Spruce Tree Campground	27.0	28.9	48.8	32.6	29.8	28.3	55.4	52.8	40.3	29.4	46.0	38.2	41.1	23.9
Spruce to Ruby Cr.	59.0	74	22.8	55.8	38.0	17.6	40.0	49.0	14.0	9.8	28.0	21.0	13.0	18.2
Prospector to Ruby Cr.	--	--	--	--	--	--	--	51.7	32.9	23.8	41.0	33.0	33.0	21.2
Calder to Avery	--	--	--	--	--	--	--	1.6	4.4	12.4	9.0	7.6	6.4	5.1
Avery to Prospector	4.0	3.4	--	2.0	3.3	4.7	1.1	12.0	21.3	7.7	19.0	7.4	5.1	3.3
Calder to Prospector Cr.	--	--	--	--	--	--	--	5.9	11.4	10.1	14.0	23.0	6.9	4.2
Calder to Ruby Cr.	--	--	--	--	--	--	--	35.0	24.3	18.3	30.0	28.0	22.6	14.1

harvest section of the St. Joe River. In 1997 in the harvest section of the St. Joe River, legal sized cutthroat trout (>350 mm) were harvested at a rate of 33%. However, this does not account for the six-fold drop in the number of cutthroat trout >300 mm because fish between 300 mm and 349 mm were not available for harvest. In addition, the number of cutthroat trout >300 mm declined in the catch-and-release section, where harvest is prohibited.

In the catch-and-release section of the St. Joe River, we used two methods to estimate population abundance of westslope cutthroat trout >200 mm during 1998. The first method used electrofishing to mark-and-recapture cutthroat trout >200 mm; the second method used electrofishing during the marking run and snorkeling during the recapture run to tag westslope cutthroat trout >200 mm (Table 3). Both methods generated a population estimate. The electrofishing density estimate was 21% greater than the snorkeling density estimate for westslope cutthroat trout >200 mm (Table 3). Electrofishing is a more intensive sampling procedure than snorkeling and requires a greater expenditure of manpower. The two-day electrofishing effort required a minimum of 112 man-hours. Population estimates by snorkeling (substituting hook-and-line for electrofishing during the marking run) would require a minimum of 32 man-hours. Electrofishing allows for a more complete estimate of most size groups, whereas estimates generated by angling/snorkeling generally limit the estimates to size groups large enough to catch and tag (or fin clip). The choice of method largely depends on manpower availability and type (quality) of the estimate required.

We compared density estimates obtained by electrofishing and snorkeling in the Copper Creek reach of the catch-and-release section of the St. Joe River. The density estimate of westslope cutthroat trout obtained by snorkeling was 64% lower than the estimated density obtained by electrofishing (Table 21). A similar comparison was conducted in 1995 and the density estimate obtained by snorkeling was 59% lower than the density estimate obtained by electrofishing (Table 21; Nelson et al. 1997). The precision of both estimates depends on the habitat that must be surveyed. Generally, a heterogeneous habitat (large rocks, woody debris, etc.) would probably result in a lower population estimate obtained by snorkeling than by electrofishing because fish have more places to hide from observers. In a homogeneous habitat, population estimates from electrofishing and snorkeling would probably be more precise (similar) because there would be fewer places where fish could hide from observers.

In the harvest section the density estimate obtained by snorkeling the transects between Packsaddle Campground and Marble Creek was 31% lower than the density estimate obtained by electrofishing from Packsaddle Campground to Marble Creek in 1998 (Table 21). In 1996 the reverse occurred as the estimated average density generated by snorkeling transects in the section between Packsaddle Campground and Marble Creek was 12% higher than the density from electrofishing the same section (Table 21).

At this point, we do not believe density estimates obtained by electrofishing one reach can be substituted for a mean density estimate obtained by snorkeling in a long-term data set without losing integrity. Several more comparisons are needed before a reliable relationship can be established between snorkeling and electrofishing in the St. Joe River. After the establishment of this relationship, density estimates generated by electrofishing might be substituted for snorkeling estimates in a long-term trend data set without losing integrity.

Table 21. Density estimates for westslope cutthroat trout captured by electrofishing or observed by snorkeling, in the St. Joe River, Idaho, 1995, 1996, and 1998.

River section	Electrofishing	Snorkeling
	Density (fish/100 m^2)	Density (fish/100 m^2)
Copper Creek to Beaver Creek (1995)	3.2	1.3
Copper Creek to Beaver Creek (1998)	0.92	0.33
Packsaddle CG to Marble Creek (1996)	0.23	0.26*
Packsaddle CG to Marble Creek (1998)	0.13	0.09*

* Densities from snorkel transects (four to eight in 1998 and one, 32 to 35 in 1996) located between Packsaddle Campground to Marble Creek.

Little North Fork Clearwater River

Exploitation of legal-sized westslope cutthroat trout appears to very low in the Little North Fork Clearwater River. Even if the total number of tags returned from both 1997 and 1998 were doubled, exploitation would still be very low (16%). By comparison, exploitation of legal sized westslope cutthroat trout in the harvest section of the St. Joe River was a minimum of 33% in 1997 (Fredericks et al. 2000).

The Little North Fork Clearwater River is a remote stream that provides an opportunity for solitude while fishing. Fishing effort in the Little North Fork Clearwater River will probably increase as the demand for solitude and fishing "less crowded" areas increases. Increased fishing effort will probably lead to increased harvest and this could lead to a reduction in trout abundance. When fishing effort increased in the St. Joe River during the 1980s, harvest restrictions were needed to provide a quality fishery. In the future, harvest restrictions may be necessary in the Little North Fork Clearwater River to protect and provide a quality fishing experience.

Upper Priest River Drainage Assessment

Abundance of westslope cutthroat trout is relatively low in the Upper Priest River. The density in the river was 0.3 fish/100 m^2 for all length groups, which was identical to the 1984 estimate (Irving 1987). For comparison, densities of westslope cutthroat trout in the catch-and-release sections of the North Fork Coeur d=Alene, Little North Fork Coeur d=Alene, and St. Joe rivers in 1998 were 0.95 fish/100 m^2 , 0.65 fish/100 m^2, and 1.09 fish/100 m^2, respectively. Similarly, the density of fish >200 mm in Upper Priest River was 0.22 fish/100 m^2, about 50% of the population of the same size class in the St. Joe River (0.42 fish/100 m^2; Table 22).

Generally, westslope cutthroat trout abundance may not have changed dramatically within tributaries of the Upper Priest River drainage based on comparisons of 1984 density estimates with those of 1998 (Table 7). The 1984 estimates were based on snorkeling observations, and the 1998 tributary

Table 22. Comparisons of population estimates for westslope cutthroat trout ∃200 mm in the St. Joe and Upper Priest rivers, Idaho, 1998.

River	Fishery type	Collection method	Number marked	Number captured	Number recaptured	Population estimate	95% confidence interval	Area (m^2)	Density (fish/ 100 m^2)
St. Joe	Harvest	Electrofishing	69	248	21	781	535-1,254	1,156,000	0.07
St. Joe	Catch-and-release	Electrofishing	29	37	7	143	79-337	34,048	0.33
St. Joe	Catch-and-release	Snorkeling	31	46	12	112	69-211	34,048	0.42
Upper Priest	Closed	Angling/ Snorkeling	78	229	47	374	285-508	166,971	0.22

estimates were primarily based on electrofishing and may not be directly comparable but provide a general comparison. In some streams the relative abundance of each species observed in 1984 was different in 1998 (Table 8). The difference may be related to sampling bias or a real change in composition. Thurow and Schill (1996) reported day and night snorkeling estimates for bull trout were 75% and 77%, respectively, of the electrofishing estimates in second order streams. This suggests that the differences in abundance of bull trout in the tributaries to the Upper Priest River based on snorkeling data in 1984 (Irving 1987), which may be an underestimate, and electrofishing data in 1998 may be greater than indicated in this report.

Abundance of bull trout in the Upper Priest River drainage and Upper Priest Lake is very low. Adult bull trout (∃350 mm) abundance in Upper Priest Lake drainage was estimated at 116 fish (95% confidence interval 54-230; Jim Fredericks, Population Management section of this report). Irving (1987) reported a density of 0.03 bull trout/100 m^2 in Upper Priest River in 1984, the same as in 1998 (Table 5).

Bull trout abundance may not have changed measurably, but this is based on only two estimates (Malcom Creek and Hughes Fork). Percentage of bull trout observed and captured indicated a shift in nine streams; six showed decreases and three showed increases (Table 8). Bull trout redd counts in the Hughes Fork drainage (1991 to 1998) appear to be declining while redd count in other tributaries in the Upper Priest watershed indicate no change (Table 13). We believe bull trout are facing several threats in the Upper Priest Lake drainage.

Lake trout *S. namaycush*, are present in Upper Priest Lake and may be competing with westslope cutthroat trout and bull trout, but it is unclear to what extent. Donald and Alger (1992) reported the displacement of bull trout by lake trout in mountain lakes. Lake trout were first stocked into Priest Lake in 1925. Lake trout were not found in Upper Priest Lake until 1985 (Mauser 1986). They appear to have steadily increased since then (Jim Fredericks, Population Management section of this report).

Brook trout are widely distributed in the Upper Priest River drainage in low abundance with the exceptions of Ruby Creek, Rock Creek and Hughes Fork. Brook trout may be affecting westslope cutthroat trout abundance in Upper Priest River tributaries through temporal and spatial competition (Irving 1987) and bull trout abundance through hybridization and competition (Leary et al. 1993). Ruby Creek was the only creek where there was a significant decline of westslope cutthroat trout and a corresponding increase in brook trout. It is unclear whether the presence of brook trout is one of the causes of the decline of westslope cutthroat trout or a replacement for cutthroat trout that have declined due to other factors. Behnke (1979) reported the replacement of westslope cutthroat trout by brook trout in the disturbed areas of two streams in the Smith River drainage in Montana where clear cutting resulted in increased erosion, sediment loads, and water temperatures suggesting habitat precipitated the shift in composition. Conversely, Varley and Gresswell (1988) reported Ain Yellowstone National Park, the introduction of brook trout has nearly always resulted in the disappearance of Yellowstone cutthroat trout.≅ Varley and Gresswell did not mention habitat alterations, but it seems likely very little disturbance had occurred.

The Upper Priest River and tributaries have been closed to fishing since before 1946. Harvest of bull trout was prohibited in Upper Priest Lake in 1984 and harvest of wild westslope cutthroat trout was prohibited in Upper Priest Lake in 1988 (adipose clipped cutthroat could be harvested). Since 1994, Upper Priest Lake has been managed as a catch-and-release fishery. This suggests angling has had a minor effect on westslope cutthroat trout and bull trout abundance in the last 10 years.

Fish Population Assessment in Bureau of Land Management Streams

Westslope cutthroat trout were distributed throughout the Emerald Empire Resource Area at different densities. Westslope cutthroat trout were found in one (Caribou Creek) out of three tributaries surveyed in the Kootenai River drainage in 1998, and the density in this stream was low (Table 9). Brook trout was the only trout or char species captured in Myrtle Creek and rainbow trout was the only trout or char species captured in Cascade Creek in 1998. In previous efforts (1990-1995) brook trout, rainbow trout, and bull trout were captured in Myrtle Creek; rainbow trout, westslope cutthroat trout, and rainbow trout x westslope cutthroat trout hybrids were captured in Caribou Creek; rainbow trout, westslope cutthroat trout, and rainbow trout X westslope cutthroat trout hybrids were captured in Cascade Creek (pers. comm. John Chatel, Fishery Biologist for the northern districts of the Panhandle National Forests). The low species composition detected in 1998 was an indication the sampling frequency was not high enough to detect trout or char species in low abundance.

The life history of westslope cutthroat trout includes three forms: adfluvial, fluvial (both migratory), and resident. Where streams are accessible to migratory fish, both migrating and resident stocks may be found. Streams with migration tend to select for the resident form.

There are migration barriers on all three of the Kootenai River tributaries (Partridge 1983). A waterfall is located approximately 3.2 km upstream on Myrtle Creek, and all three surveyed stream reaches were above this barrier. An impassable cascade reach is located approximately 1.2 km upstream on Cascade Creek; one stream reach was below this barrier and two surveyed reaches were above. A culvert (passable only in very high water) is located on Caribou Creek about 0.5 km upstream from the confluence with Myrtle Creek, and a waterfall is located about 1.2 km upstream as well. All three of the surveyed stream reaches were above the first barrier. Migratory fish have access to the areas below the barriers, and fish populations above these barriers should be classified as resident stocks.

Westslope cutthroat trout densities in Falls and Black Prince creeks (St. Joe River) were low, and the brook trout density was high in Falls Creek (Table 9). Black Prince Creek was surveyed in 1978 (Ringe et al. 1978). The trout and char species composition was the same as it was in 1998. There is a barrier waterfall on Falls Creek (at the mouth) and one on Black Prince Creek (1.2 km upstream); all three surveyed stream reaches in each stream were above the falls. The westslope cutthroat trout populations above these barriers should be classified as resident stocks.

Blue Creek is a tributary to Coeur d=Alene Lake. The high number of young-of-the-year westslope cutthroat trout captured and the similarity of the length frequency (Appendix H) to that reported by Lukens (1978) indicated that this population of westslope cutthroat trout is probably an adfluvial stock (resident westslope cutthroat trout stock may also be present). The Blue Creek population of westslope cutthroat trout provides a source of adfluvial cutthroat trout to a depressed lake run population, and efforts should be made to prevent the decline of this westslope cutthroat trout population.

The westslope cutthroat trout populations in tributaries to the Coeur d=Alene River (Latour and Big Baldy creeks and Skeel Gulch) appear to be depressed in some reaches and high in others (Table 9). The westslope cutthroat trout population in Latour Creek appeared depressed. High water flow and the great width of the stream may have affected the capture of trout that resulted in a low abundance estimate. Latour Creek was surveyed in 1978 and in 1984-1985 (Ringe et al. 1978; Apperson et al. 1988). The species composition in 1978 and 1984-1985 was the same as in 1998. Apperson et al. (1988) reported a higher density of westslope cutthroat trout (5.3 fish/ 100 m^2) in 1984 and 1985 than was estimated in 1998 (1.4 fish/100 m^2). Apperson et al. (1988) reported the westslope cutthroat trout population in Latour

Creek (and probably in Big Baldy Creek) was comprised, in part, of migratory stocks. Apperson also reported poor trout habitat in the lower section of the stream. Apperson et al. (1988) reported capturing migratory westslope cutthroat trout in Skeel Gulch. Currently, an impassable culvert near the mouth blocks upstream migration, and all three surveyed stream reaches were above the barrier.

The highest densities of westslope cutthroat trout were found in tributaries of the South Fork Coeur d=Alene River (Table 9). The highest density occurred in Jackass Creek, which has a migration barrier near the mouth. The second highest density occurred in McFarren Gulch, which does not have a migration barrier. Many of the tributaries surveyed in 1998 had migration barriers. Placer Creek has a concrete flume at the mouth that blocks upstream migration resulting in resident populations of westslope cutthroat trout in Dry and Cranky gulches, Experimental Draw and Placer Creek. Placer Creek was surveyed in 1978 (Ringe et al. 1978). The only salmonid species captured were westslope cutthroat trout and one rainbow trout. In 1998, we captured westslope cutthroat trout and brook trout. Barriers occur on Big Creek near the mine site, prohibiting upstream migration, and all surveyed stream reaches were above the barriers. This results in resident populations of westslope cutthroat trout occurring in West Fork Big Creek and Big Creek upstream from the barrier.

In 1998 Douglas Gulch, a tributary to East Fork Pine Creek, was surveyed. We captured westslope cutthroat trout and brook trout. Ringe et al. (1978) reported a potential barrier in Douglas Gulch near the mouth.

Streams without complete barriers probably have both migratory and resident stocks. Capturing large (>300 mm) adult spawning cutthroat in the spring would help identify where migratory stocks are present. However, the westslope cutthroat trout we captured in July and August did not exceed 250 mm in length, making identification of the cutthroat trout stocks present difficult.

Westslope cutthroat trout have been petitioned for review under the Endangered Species Act. Westslope cutthroat trout abundance can be affected by habitat conditions, presence of non-native trout species, and angling. Our data indicate westslope cutthroat trout abundance is good in many of the streams surveyed and that the species is widely distributed.

Brook trout are present in several streams in the Emerald Empire Resource Area. It is unclear whether the presence of brook trout caused the decline of westslope cutthroat trout or if some other factor (like degraded habitat) caused the decline of cutthroat trout. Behnke (1979) reported the replacement of westslope cutthroat trout by brook trout in the disturbed areas of two streams in the Smith River drainage in Montana where clear cutting resulted in increased erosion, sediment loads, and water temperatures. Varley and Gresswell (1988) reported Ain Yellowstone National Park, the introduction of brook trout has nearly always resulted in the disappearance of Yellowstone cutthroat trout≅. Varley and Gresswell did not mention habitat alterations, but we can assume very little disturbance had occurred.

The streams surveyed in the Emerald Empire Resource Area provide an opportunity for anglers to fish a small stream for trout and char. There is a demand by some anglers for small stream fisheries. Land management activities should prevent the degradation of these small stream fisheries.

Hatchery Trout Evaluation

Return rates for hatchery rainbow trout stocked into the Moyie River were below the recommended statewide return rate of 40%. Even if return rates were adjusted for a 50% noncompliance for tag returns, the return rates would still be below the statewide recommendation. The mean lengths for the Colorado River rainbow trout (225 mm) and domestic Kamloops rainbow trout (220 mm) may have negatively affected return rates. Put-and-take rainbow trout longer than 250 mm returned at a higher rate than fish less than 250 mm (Davis et al. 1996), but it is doubtful that stocking larger fish in the Moyie River would have improved return rates to meet the statewide recommendation. The best return rate (38%) from rivers in the Panhandle Region occurred in the St. Joe River under the most ideal conditions of stocking in the most popular sites during the period of highest fishing effort (Fredericks et al. 1997). Typically, return rates in the Panhandle Region rivers range from 22% to 29% (Fredericks et al. 1997).

The cost of rearing and stocking the 1,903 tagged fish for the Moyie River was approximately \$0.49/fish or \$926 (John Thorpe, Hatchery Supervisor, personal communication), making the cost per fish caught \$10.41 each. This is not an economical use of sportsmen dollars and strongly suggests that stocking of put-and-take rainbow trout should be discontinued in the Moyie River. An alternative management strategy could emphasize wild trout. A more in-depth study of the Moyie River planned for 1999 will provide information to recommend the best management direction. If stocking is necessary for continued angler satisfaction, catch-out ponds could be developed adjacent to the river.

Return rates for hatchery rainbow stocked into the St. Maries River and Big Creek were well below the recommended statewide return rate of 40%. Mean lengths of these fish were 255 mm and 270 mm in the St. Maries River and Big Creek, respectively, and an increase in stocking size may not significantly improve return rates. The cost of tagged rainbow caught from the St. Maries River was \$7.35/fish and was \$4.90/fish for those from Big Creek. Use of hatchery fish in either of these sites is probably not economically justified. However, continued stocking in these streams should be carefully reviewed because of a need to provide anglers with a fishery not currently provided by wild fish.

Bull Trout Spawning Escapement

Pend Oreille Lake Drainage

The number of bull trout redds counted in the Pend Oreille Lake drainage was the highest since 1985 (Table 12). More redds were counted in 11 of the 17 streams reaches in 1998 than in 1997. Some of the increase in the number of redds may be attributed to the prohibition of bull trout harvest in the Clark Fork River and Pend Oreille Lake in 1996. Stelfox (1997) reported an increase from 54 adult spawners in 1991, prior to harvest restrictions, to 650 adult spawners in 1996 in Smith-Dorrien Creek, a tributary to Lower Kananskis Lake, Alberta. Allan (1997) reported an increase from 35 redds to an average of 53 redds (since 1991) in Line Creek, British Columbia, resulting from harvest restrictions on the Fording River/Elk River system. Previous regulations in Pend Oreille Lake protected bull trout under 500 mm, so the total harvest closure extended protection to a relatively small percentage of the population but a potentially large portion of the spawning population. The full potential increase from harvest restrictions in the Pend Oreille Lake system may not be realized due to the presence of exotic trout species. Jim Stelfox (Alberta Environmental Protection, Natural Resources Service, Fisheries Management Division Calgary, personal communication) compared increases in the number of bull trout after harvest restrictions were implemented in streams with and without exotic species. The increases in the number of bull trout were higher in streams without exotics.

Upper Priest Lake Drainage

The bull trout population in Upper Priest River and Upper Priest Lake is very low. The adult bull trout population (>400 mm) in Upper Priest Lake was estimated to be 116 fish (95% confidence limits, 54-230, Jim Fredericks, Population Management section in this report). Threats to bull trout abundance in the Upper Priest Lake drainage include the presence of brook trout and lake trout. Logging and logging roads also pose a threat to bull trout habitat. Increased sedimentation and the past removal of trees from riparian areas reducing shade and the recruitment of woody debris to the streams have impaired habitat quality.

St. Joe River Drainage

Available information indicates the bull trout population in the St. Joe River system is the only one remaining in the Spokane River drainage. However, population numbers based on redd counts are very low when compared to the Pend Oreille Lake drainage bull trout population and are lower than those estimated for Upper Priest Lake. Spawning activity is primarily confined to the cold, higher elevation upper reaches of the St. Joe River basin where very little logging has occurred and road densities are low. The fewer bull trout redds counted in 1998 may be caused by fluctuations in spawning escapement common to populations with low abundance (Rieman and McIntyre 1995).

Little North Fork Clearwater River Drainage

The population of bull trout in the upper Little North Fork Clearwater River appears to be low. The density of juvenile bull trout upstream from Adair Creek was 0.28 fish/100 m^2 in 1997 (Fredericks et al. 1997) indicating there were only a few redds in the upper Little North Fork Clearwater River drainage in 1994 and 1995. Redd detection can be very difficult for observers in this area where there is very little periphyton on the substrate, so “cleaned” gravel associated with redd construction in the fall can not be used to identify redds. Other factors such as substrate orientation and classic redd construction patterns, i.e. a depression followed by a mound of loose gravel, was used to locate redds. Low redd counts could also be a function of bull trout spawning outside the survey reaches. Redd surveys should be extended to include the Little North Fork Clearwater River between Adair Creek and Lund Creek to determine if adult bull trout are using this reach to spawn.

Monitoring Bull Trout and Westslope Cutthroat Trout Movements in the St. Joe River Using Radio Telemetry

Bull Trout

The St. Joe River bull trout population appears to have the same general migration pattern as other bull trout populations in Rapid River, Idaho (Schill et al. 1994); Kalewa River, British Columbia (Hvenegoard and Fairles 1998); West Castle River, British Columbia (Boag and Hvenegoard 1997); and the Athabasca River, Alberta (McLeod and Clayton 1997). Bull trout probably enter the St. Joe River in April or May and begin to migrate steadily upstream until they reach spawning areas by late July and August. The migration from release sites (when transmitters were implanted) to spawning areas took approximately 35 to 70 days (June 16 to August 26, 1998). Surgery may have delayed the start of upstream migration one to three weeks. However, bull trout appeared in the spawning areas at the same time in 1998 as in 1997 (Mike Owen, USFS Panhandle National Forests Fisheries Biologist, personal communication). Bull trout in the Duncan River, British Columbia migrated to spawning areas in about 50 days ($\pm$21 days) (David O=Brien, doctoral candidate, University of British Columbia, personal communication).

The radio-tagged bull trout we were able to follow remained in the spawning areas for approximately 14 to 20 days (August 26 to September 18). Bull trout in Rapid River remained in the spawning areas approximately 21 to 28 days (Schill et al. 1994), and in the Duncan River, bull trout remained in spawning areas 52 days ($\pm$15 days; David O=Brien, personal communication).

The post spawning migrations in the St. Joe River had two peaks. The first peak probably occurred immediately after spawning, and these fish may have reached Coeur d=Alene Lake in less than 32 days because their transmitter signals were not located in the river on September 29, 1998. The other group reached overwintering areas in about 60 to 80 days. In Rapid River downstream migrations took about 30 to 40 days (Schill et al. 1994). In the Athabasca River, bull trout migrated downstream to overwintering areas in about 30 days (McLeod and Clayton 1997). In the Duncan River, downstream migration took an average of $\pm$15 days (David O=Brien, personal communication).

Post spawning mortality of the St. Joe River radio tagged bull trout was 28.6 % assuming fish not found survived after reaching Coeur d=Alene Lake. Schill et al. (1994) reported a natural mortality of 67% for radio tagged bull trout in Rapid River in 1992. Elle et al. 1994 reported a 58% mortality of radio tagged bull trout >450 mm in Rapid River in 1993. The bull trout that died in the St. Joe River ranged in length from 410 mm to 680 mm and were probably first time spawners (based on lengths, no age data was available). Bull trout in the Pend Oreille Lake drainage matured at four to six years and ranged in lengths from 403 mm to 578 mm (Pratt 1984). Stelfox (1997) reported first time spawners in Smith-Darren Creek, Alberta, ranged in length from 509 mm to 704 mm. Brown (1984) reported that first time adfluvial female spawners were five to seven years old in the Wenatchee National Forest, Oregon.

Westslope Cutthroat Trout

Water temperatures in the St. Joe River were high during surgery, often exceeding 16EC. The added stress of high water temperatures and the invasive procedure necessary to implant radio transmitters may have increased the potential for post surgical mortalities. We experienced a relatively high post surgery mortality rate of 38%, which also occurred in cutthroat trout from the Teton River, Idaho following implantation of radio transmitters in August and September 1998. The high water temperatures were given as a contributing cause (Bill Schrader, Department, personal communication).

Westslope cutthroat trout appeared to begin the downstream migration in late October or early November. Cutthroat trout were observed by snorkeling in several areas upstream from Gold Creek on October 26, 1997. On November 20, 1997, no cutthroat trout were observed upstream of Gold Creek in the same areas snorkeled in October. Radio telemetry indicated the same movement pattern in 1998. Cutthroat trout were located in the area upstream of Gold Creek on October 26, 1998 (Figure 32), and by mid-November most of the cutthroat trout had moved downstream (Figure 32). Hunt and Bjornn (1992) also reported this same general pattern in the St. Joe River in 1989.

The start of the downstream movement for westslope cutthroat trout in the St. Joe River upstream from Gold Creek occurs after September 10 when harvest of cutthroat trout in the St. Joe River downstream of Prospector Creek closes. It is not known if legal sized cutthroat trout (>355 mm) that reside between Gold Creek and Prospector Creek move into the harvest area before September 10, becoming vulnerable to harvest. But, if we assume legal sized cutthroat trout in this area begin downstream movement at the same time as upstream cutthroat trout or even as early as October, then the September 10 closure date protects legal sized cutthroat trout from harvest.

Identification and protection of key overwintering habitat is necessary to maintain a healthy westslope cutthroat trout population in the St. Joe River. This critical habitat appears to be pools and deep runs. Most of the fluvial westslope cutthroat trout may overwinter in this type of habitat downstream from Marble Creek. Even though our sample size was small, 63% of the tagged cutthroat trout were located downstream from Marble Creek. Efforts should be made to prevent degradation of this critical winter habitat.

RECOMMENDATIONS

1. Conduct biennial snorkeling surveys in the Little North Fork Coeur d=Alene, North Fork Coeur d=Alene, and St. Joe rivers using snorkeling or electrofishing.

2. Conduct biennial electrofishing population estimates in the Little North Fork Coeur d=Alene, North Fork Coeur d=Alene, and St. Joe rivers to correspond with snorkeling surveys.

3. Discontinue stocking the Moyie River with hatchery reared put-and-take rainbow trout.

4. Evaluate the need to continue stocking the St. Maries River and Big Creek (St. Joe River) with put-and-take rainbow trout in order to meet angler expectations.

5. Survey all 17 bull trout spawning streams in the Pend Oreille drainage in 1999.

6. Monitor bull trout abundance through redd counts in four index streams in the St. Joe River drainage: Medicine Creek, Wisdom Creek, St. Joe River from Heller Creek to Medicine Creek, and St. Joe River from Medicine Creek upstream to the cascades below St. Joe Lake.

7. Count bull trout redds in the Upper Priest Lake drainage the first week of October.

8. Survey the entire Upper Priest River for three years to establish new bull trout redd counting areas.

9. Count bull trout redds in the upper Little North Fork Clearwater River, Lund, Lost Lake, and Little Lost Lake creeks, Idaho.

10. Coordinate a multi-agency survey of the Moyie River drainage in 1999 to assess distribution and abundance of westslope cutthroat trout, redband trout, bull trout, and nongame fish.

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APPENDICES

Appendix A. Summary of snorkeling observations in transects in the North Fork Coeur d'Alene River, Idaho, August 1998.

						Number of fish observed					
						Cutthroat		Wild rainbow			
New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	≤300 (mm)	>300 (mm)	≤300 (mm)	>300 (mm)	Whitefish[1]	Other[2]
1	34	5 c&r	66	15	990	7	2	0	0	8	0
2	35	5 c&r	38	14.5	551	16	2	0	0	130	0
3	36	5 c&r	29	15.7	455.3	16	3	0	0	0	0
4	37	5 c&r	52	14.8	770	0	0	0	0	0	0
5	38	5 c&r	126	17.1	2155	10	2	0	0	0	0
6	1	4 c&r	50	16.9	845	7	0	0	0	0	0
7	2	4 c&r	58	15.2	882	0	1	0	0	0	0
8	3	4 c&r	67	13	871	5	1	0	0	0	0
9	4	4 c&r	70	25	1,750	0	0	0	0	0	0
10	5	4 c&r	128.5	16.4	2107	63	3	0	0	13	0
11	6	3 c&r	60	19.8	1,188	22	2	0	0	45	0
12	7	3 c&r	47.5	18	855	12	0	0	0	0	0
13	8	3 c&r	91	24	2,184	4	0	0	0	0	0
14	9	3 c&r	92.5	26.3	2,432	7	0	1	0	232	19
15	10	3 c&r	110	27	2,970	14	0	0	0	67	9
16	11	2 c&k	66.6	33	2,198	0	1	0	0	2	0
17	12	2 c&k	140	23.7	3,318	3	1	0	0	3	0

Appendix A. Continued.

New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	Number of fish observed: Cutthroat ≤300 (mm)	Cutthroat >300 (mm)	Wild Rainbow ≤300 (mm)	Wild Rainbow >300 (mm)	Whitefish[1]	Other[2]
18	13	2 c&k	117	43.7	5,113	5	1	0	0	8	0
19	14	2 c&k	153.8	38	5,844	64	3	11	0	103	50
20	15	2 c&k	108.2	41	4,436	8	0	0	0	5	0
21	16	1 c&k	130	37.7	4,901	15	0	0	0	10	25
22	17	1 c&k	106.3	47	4,996	21	0	16	0	95	75
23	18	1 c&k	160	36	5,760	8	0	10	0	24	0
24	19	1 c&k	160	36	5,760	47	0	10	0	0	55
25	20	1 c&k	160	57	9,120	38	0	0	0	62	20
26	21	1 c&k	129	31	3,999	0	1	14	0	10	62
27	22	1 c&k	50	37	1,850	0	0	5	0	168	67
28	23	1 c&k	110	36	3,960	1	0	8	0	54	0

[1] Whitefish includes adults and juveniles
[2] Other includes squawfish and suckers

Appendix B. Densities of fish observed while snorkeling in transects in the North Fork Coeur d'Alene River, Idaho, August 1998.

New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	Density of fish observed: Cutthroat No./m^2	Cutthroat No./100 m^2	Wild rainbow No./m^2	Wild rainbow No./100m^2
1	34	5 c&r	66	15	990	0.012	1.21	0	0
2	35	5 c&r	38	14.5	551	0.033	3.27	0	0
3	36	5 c&r	29	15.7	455.3	0.042	4.17	0	0
4	37	5 c&r	52	14.8	770	0	0	0	0
5	38	5 c&r	126	17.1	2155	0.006	0.56	0	0
6	1	4 c&r	50	16.9	845	0.008	0.83	0	0
7	2	4 c&r	58	15.2	882	0.001	0.11	0	0
8	3	4 c&r	67	13	871	0.007	0.69	0	0
9	4	4 c&r	70	25	1,750	0	0	0	0
10	5	4 c&r	128.5	16.4	2107	0.031	3.13	0	0
11	6	3 c&r	60	19.8	1,188	0.020	2.02	0	0
12	7	3 c&r	47.5	18	855	0.014	1.40	0	0
13	8	3 c&r	91	24	2,184	0.002	0.18	0	0
14	9	3 c&r	92.5	26.3	2,432	0.003	0.29	0.001	0.08
15	10	3 c&r	110	27	2,970	0.005	0.47	0	0
16	11	2 c&k	66.6	33	2,198	<0.001	0.05	0	0
17	12	2 c&k	140	23.7	3,318	0.001	0.12	0	0
18	13	2 c&k	117	43.7	5,113	0.001	0.12	0	0
19	14	2 c&k	153.8	38	5,844	0.011	1.14	0.003	0.29
20	15	2 c&k	108.2	41	4,436	0.002	0.18	0	0

Appendix B. Continued.

New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	Density of fish observed: Cutthroat No./m^2	Cutthroat No./100 m^2	Wild rainbow No./m^2	Wild rainbow No./100m^2
21	16	1 c&k	130	37.7	4,901	0.003	0.31	0	0
22	17	1 c&k	106.3	47	4,996	0.004	0.42	0.004	0.44
23	18	1 c&k	160	36	5,760	0.001	0.14	0.002	0.23
24	19	1 c&k	160	36	5,760	0.008	0.82	0	0
25	20	1 c&k	160	57	9,120	0.004	0.42	0	0
26	21	1 c&k	129	31	3,999	<0.001	0.03	0.005	0.45
27	22	1 c&k	50	37	1,850	0	0	0.005	0.54
28	23	1 c&k	110	36	3,960	<0.001	0.03	0.003	0.30

Appendix C. Number of fish observed in snorkeling transects in the Little North Fork Coeur d'Alene River, Idaho, August 1998.

New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	Cutthroat <300	Cutthroat >300	Wild rainbow <300	Wild rainbow >300	Brook trout <300	Brook trout >300	Whitefish[1]	Other[2]
1	33	7 c&k	50	25	1,250	0	0	6	0	0	0	0	0
2	32	7 c&k	150	29	4,350	8	0	2	3	0	0	0	0
3	31	7 c&k	160	20	3,200	7	0	26	0	4	0	0	0
4	30	7 c&k	160	20	3,200	6	0	9	4	0	0	0	0
5	29	7 c&k	90	15.5	1,395	7	0	0	0	1	0	3	0
6	28	7 c&k	80	20	1,600	34	0	0	0	8	0	1	0
7	27	7 c&k	68	18.9	1,285	2	0	0	0	0	0	0	0
8	26	7 c&k	35	21.9	767	3	0	0	0	0	0	0	0
9	25	8 c&r	60	19.8	1,176	0	0	0	0	0	0	0	0
10	24	8 c&r	77	16.3	1,255	4	0	0	0	0	0	0	0
11	101	8 c&r	60	13.6	816	10	0	0	0	0	0	0	0
12	102	8 c&r	64	10.1	646	13	0	0	0	0	0	0	0
13	104	8 c&r	61	11.3	689	3	0	0	0	0	0	0	0

[1]Whitefish includes adults and juveniles.
[2]Other includes squawfish and suckers.

Appendix D. Estimated densities of trout observed in snorkeling transects in the Little North Fork Coeur d'Alene River, Idaho, August 1998.

New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	Cutthroat No./m^2	Cutthroat No. /100m^2	Wild rainbow No./m^2	Wild rainbow No. /100m^2	Brook trout No./m^2	Brook trout No. /100m^2
1	33	7 c&k	50	25	1,250	0	0	0	0	0	0
2	32	7 c&k	150	29	4,350	0.002	0.18	0.005	0.48	0	0
3	31	7 c&k	160	20	3,200	0.002	0.22	0.001	0.11	0.001	0.13
4	30	7 c&k	160	20	3,200	0.002	0.19	0.008	0.81	0	0
5	29	7 c&k	90	15.5	1,395	0.005	0.50	0.004	0.41	0.001	0.07
6	28	7 c&k	80	20	1,600	0.021	2.13	0	0	0.005	0.50
7	27	7 c&k	68	18.9	1,285	0.002	0.16	0	0	0	0
8	26	7 c&k	35	21.9	767	0.004	0.39	0	0	0	0
9	25	8 c&r	60	19.8	1,176	0	0	0	0	0	0
10	24	8 c&r	77	16.3	1,255	0.003	0.32	0	0	0	0
11	101	8 c&r	60	13.6	816	0.012	1.23	0	0	0	0
12	102	8 c&r	64	10.1	646	0.020	2.01	0	0	0	0
13	104	8 c&r	61	11.3	689	0.004	0.44	0	0	0	0

Appendix E. Summary of snorkeling observations in transects in the St. Joe River, Idaho, August 1998.

						Number of fish observed							
						Cutthroat		Bull trout		Wild rainbow		Whitefish[1]	Other[2]
New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	≤300 (mm)	>300 (mm)	≤300 (mm)	>300 (mm)	≤300 (mm)	>300 (mm)		
1	29	c&k	180	38	6,840	3	0	0	0	1	0	47	127
2	30	c&k	230	45	10,350	0	0	0	0	0	0	101	170
3	31	c&k	200	40	8,000	13	2	0	0	0	0	40	72
4	32	c&k	63.7	54	3,440	2	0	0	0	0	0	25	97
5	33	c&k	150	47.5	7,125	0	0	0	0	0	0	0	0
6	34	c&k	86	30	2,580	5	0	0	0	3	0	33	6
7	35	c&k	75	40	3,000	11	0	0	0	14	1	26	41
8	1	c&k	85	51	4,335	0	0	0	0	0	0	0	3
9	2	c&k	89	33	2,937	1	1	0	0	0	0	77	44
10	3	c&k	85	14	1,190	6	0	0	0	0	0	8	0
11	4	c&k	68	16	1,088	3	0	0	0	0	0	6	6
12	5	c&k	90	26	2,340	6	1	0	0	1	0	2	19
13	6	c&k	155	32	4,960	2	0	0	0	1	1	5	5
14	7	c&k	90	30	2,790	3	0	0	0	17	0	30	30
15	8	c&r	143	26	3,718	1	0	0	0	2	0	63	42
16	9	c&r	125	24.9	3,113	23	1	1	0	2	0	13	26
17	10	c&r	193	22.7	4,381	40	10	0	0	2	0	17	43
18	11	c&r	82	26.6	2,181	9	0	0	0	0	0	2	0
19	12	c&r	55	29.9	1,645	22	2	1	0	0	0	12	11
20	13	c&r	95	34.5	3,278	15	0	0	0	1	0	16	0

Appendix E. Continued.

New transect number	Old transect number	River section	Length (m)	Width (m)	Area (m^2)	Number of fish observed: Cutthroat ≤300 (mm)	Cutthroat >300 (mm)	Bull trout ≤300 (mm)	Bull trout >300 (mm)	Wild rainbow ≤300 (mm)	Wild rainbow >300 (mm)	Whitefish[1]	Other[2]
22	15	c&r	78.5	17.1	1,342	35	0	0	0	0	0	5	6
23	16	c&r	90.5	16.7	1,511	20	0	0	0	0	0	0	2
24	17	c&r	122	15	1,830	17	0	0	0	0	0	1	2
25	18	c&r	96	15.7	1,507	33	0	0	0	0	0	0	17
26	19	c&r	121	23.8	2,880	5	0	0	0	0	0	0	2
27	20	c&r	70	23.4	1,638	18	3	0	0	0	0	10	10
28	21	c&r	43	24.7	1,062	20	8	0	0	0	0	15	15
29	22	c&r	58	18.3	1,061	20	2	0	0	0	0	15	5
30	23	c&r	50	16.5	825	11	0	0	0	0	0	0	0
31	24	c&r	88	19	1,672	28	1	0	0	0	0	0	0
32	25	c&r	70.8	17.5	1,239	4	0	0	0	0	0	0	0
33	26	c&r	80	21	1,680	2	1	0	0	0	0	0	0
34	27	c&r	46	17.5	805	15	11	0	0	0	0	15	10
35	28	c&r	39.5	17	672	21	5	0	0	0	0	12	10

[1] Whitefish includes the number of juveniles and adults.
[2] Includes squawfish and suckers.

Appendix F. Densities for fish observed while snorkeling in transects in the St. Joe River, Idaho, August 1998.

New transect number	Old transect number	Densities of fish observed							
		Cutthroat		Bull trout		Wild rainbow		Total trout	
		No./m^2	No./100m^2	No./m^2	No./100m^2	No./m^2	No./100m^2	No./m^2	No./100m^2
1	29	0.001	0.06	0	0	0	0	0.001	0.06
2	30	0	0	0	0	0	0	0	0
3	31	0.002	0.19	0	0	0	0	0.002	0.19
4	32	0.001	0.06	0	0	0	0	0.001	0.06
5	33	0	0	0	0	0	0	0	0
6	34	0.002	0.19	0	0	0.001	0.12	0.003	0.31
7	35	0.004	0.37	0	0	0.005	0.47	0.009	0.87
8	1	0	0	0	0	0	0	0	0
9	2	0.001	0.07	0	0	0	0	0.001	0.07
10	3	0.005	0.50	0	0	0	0	0.005	0.50
11	4	0.003	0.28	0	0	0	0	0.003	0.28
12	5	0.003	0.30	0	0	<0.001	0.04	0.012	1.20
13	6	<0.001	0.04	0	0	<0.001	0.04	0.001	0.08
14	7	0.001	0.11	0	0	0.006	0.61	0.007	0.72
15	8	<0.001	0.03	0	0	0.001	0.08	0.001	0.08
16	9	0.008	0.77	<0.001	0.03	0.001	0.06	0.009	0.87
17	10	0.011	1.14	0	0	0.001	0.07	0.012	1.19
18	11	0.004	0.41	0	0	0	0	0.004	0.41
19	12	0.015	1.46	<0.001	0.06	0	0	0.015	1.52
20	13	0.005	0.46	0	0	0.001	0.06	0.005	0.49
21	14	0.017	1.69	0	0	0	0	0.017	1.69

Appendix F. Continued.

New transect number	Old transect number	Densities of fish observed							
		Cutthroat		Bull trout		Wild rainbow		Total trout	
		No./m^2	No./100m^2	No./m^2	No./100m^2	No./m^2	No./100m^2	No./m^2	No./100m^2
22	15	0.026	2.61	0	0	0	0	0.026	2.61
23	16	0.013	1.32	0	0	0	0	0.013	1.32
24	17	0.009	0.93	0	0	0	0	0.009	0.93
25	18	0.022	2.19	0	0	0	0	0.022	2.19
26	19	0.002	0.17	0	0	0	0	0.002	0.17
27	20	0.013	1.28	0	0	0	0	0.013	1.28
28	21	0.026	2.64	0	0	0	0	0.026	2.64
29	22	0.021	2.07	0	0	0	0	0.021	2.07
30	23	0.013	1.33	0	0	0	0	0.013	1.33
31	24	0.017	1.73	0	0	0	0	0.017	1.73
32	25	0.003	0.32	0	0	0	0	0.003	0.32
33	26	0.002	0.18	0	0	0	0	0.002	0.18
34	27	0.032	3.23	0	0	0	0	0.032	3.23
35	28	0.039	3.87	0	0	0	0	0.039	3.87

Appendix G. Composition and abundance of trout and char captured by electrofishing in tributaries of the Upper Priest River drainage, including three tributaries of Upper Priest Lake, Idaho, July 1998.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm			Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
					Pass 1	Pass 2	Pass 3			
Boulder Cr.	1-1	Cutthroat	71-193	0	3	--	--	--	--	--
	1-2	Cutthroat	57-111	1	1	--	--	--	--	--
	1-3	Cutthroat	67-144	0	2	3	--	--	--	--
	2-1	Cutthroat	60-116	0	3	2	--	--	--	--
	2-2	Cutthroat	60-140	0	6	5	3	17	14-28	7.1
	2-3	Cutthroat	59-150	1	7	0	--	7	7-8	3.6
	3-1	Cutthroat	87-161	0	6	2	--	8	8-10	5.4
	3-2	Cutthroat	46-250	4	2	3	--	--	--	--
	3-3	Cutthroat	74-104	0	2	--	--	--	--	--
Gold Cr.	1-1	Cutthroat	165-294	0	2	--	--	--	--	--
		Bull trout	104-147	0	4	--	--	--	--	--
	1-2	Cutthroat	147-242	0	2	--	--	--	--	--
		Bull trout	52-145	1	7	--	--	--	--	--
	1-3	Cutthroat	82-174	0	8	--	--	--	--	--
		Bull trout	47-139	1	8	--	--	--	--	--
	2-1	Cutthroat	77-152	0	2	--	--	--	--	--
		Bull trout	90-197	0	5	--	--	--	--	--
Gold Cr	2-2	Cutthroat	103-247	0	1	2	0	--	--	--
		Bull trout	125-195	0	3	1	0	4	4-6	2.0

Appendix G. Continued.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
.	2-3	Zero fish captured site located above barrier falls								
	2-3	Zero fish captured site located above barrier falls								
	3-1	Zero fish captured site located above barrier falls								
	3-2	Zero fish captured site located above barrier falls								
	3-3	Zero fish captured site located above barrier falls								
South Fork Gold Cr.	1-1	Cutthroat	56-148	2	9	--	--	--	--	--
	1-2	Zero fish captured site located above barrier falls								
	1-3	Zero fish captured site located above barrier falls								
Muskegon Cr.	1-1	Cutthroat	71-148	0	5	--	--	--	--	--
	1-2	Cutthroat	89-164	0	13	0	--	13	13-14	8.9
	1-3	Cutthroat	50-142	1	8	--	--	--	--	--
Jackson Cr.	1-1	Cutthroat	67-169	0	9	3	--	12	12-14	8.1
	1-2	Cutthroat	67-149	0	8	--	--	--	--	--
		Bull trout	125	0	1	--	--	--	--	--
Jackson Cr.	1-3	Cutthroat	63-112	0	3	--	--	--	--	--
		Bull trout	137	0	1	--	--	--	--	--
	2-1	Cutthroat	56-160	1	9	--	--	--	--	--

Appendix G. Continued.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
	2-2	Cutthroat	67-139	0	7	--	--	--	--	--
Bench Cr.	1-1	Cutthroat	58-98	1	1	--	--	--	--	--
		Bull trout	152	0	1	--	--	--	--	--
	1-2	Cutthroat	63-132	0	5	--	--	--	--	--
	1-3	Cutthroat	117-202	0	5	--	--	--	--	--
		Bull trout	169-181	0	2	--	--	--	--	--
	2-1	Cutthroat	94-143	0	3	--	--	--	--	--
Hughes Fork below Meadows	1-1	Cutthroat	98-130	0	2	--	--	--	--	--
		Bull trout	283	0	1	--	--	--	--	--
		Brook tr	91-196	0	5	--	--	--	--	--
	1-2	Cutthroat	50-82	1	2	--	--	--	--	--
		Brook tr	117-233	0	2	--	--	--	--	--
	1-3	Bull trout	100-105	0	2	--	--	--	--	--
	2-1	This section had too much water to effectively sample								
	2-2	Cutthroat	102	0	1	--	--	--	--	--
		Bull trout	96	0	1	--	--	--	--	--
		Brook tr	172	0	1	--	--	--	--	--
Hughes Fork Below Meadows	2-3	Cutthroat	84-153	0	5	--	--	--	--	--
		Brook tr	143	0	1	--	--	--	--	--

Appendix G. Continued.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
	3-1	Cutthroat	68-138	0	6	--	--	--	--	--
		Bull trout	58-169	1	6	--	--	--	--	--
		Brook tr	51-159	1	2	--	--	--	--	--
	3-2	Cutthroat	51-150	6	7	4	--	12	11-18	3.2
		Bull trout	50-131	1	4	1	--	5	5-6	1.5
		Brook tr	57-130	2	1	1	--	--	--	--
	3-3	Site flooded by beaver dam, site not sampled								
Hughes Fork above Meadows	4-1	Bull trout	155	0	1	--	--	--	--	--
	4-2	Cutthroat	148	0	1	0	--	1	1-2	0.4
		Bull trout	145	0	1	0	--	1	1-2	0.4
	4-3	Cutthroat	165-179	0	2	--	--	--	--	--
	5-1	Cutthroat	79-166	0	9	--	--	--	--	--
	5-2	Cutthroat	123-199	0	7	--	--	--	--	--
	5-3	Cutthroat	127-189	0	5	--	--	--	--	--
Hughes Fk above Meadows	6-1	Cutthroat	126	0	1	--	--	--	--	--
		Bull trout	190	0	1	--	--	--	--	--
	6-2	Cutthroat	131-166	0	2	--	--	--	--	--
		Brook tr	54-368	1	1	--	--	--	--	--

Appendix G. Continued.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
Ruby Cr.	1-1	Cutthroat	80-117	0	2	--	--	--	--	--
		Brook tr	43-121	4	2	--	--	--	--	--
	1-2	Cutthroat	68-110	0	2	--	--	--	--	--
		Brook tr	47-151	1	2	--	--	--	--	--
	1-3	No trout captured, equipment problems								
	2-1	Cutthroat	97	0	1	--	--	--	--	--
		Brook tr	145	0	1	--	--	--	--	--
Cedar Cr.	1-1	Cutthroat	110-132	0	2	--	--	--	--	--
		Bull tr	54	1	0	--	--	--	--	--
	1-2	Cutthroat	72-107	0	3	--	--	--	--	--
		Bull trout	50	1	0	--	--	--	--	--
	1-3	Cutthroat	80-183	0	5	--	--	--	--	--
	2-1	Cutthroat	64-212	0	38	19	--	72	57-96	22.5
		Bull trout	67-138	0	1	1	--	--	--	--
	2-2	Cutthroat	66-192	18	--	--	--	--	--	--
Cedar Cr.	2-3	Cutthroat	33-221	2	31	--	--	--	--	--
	3-1	Cutthroat	42-234	2	27	--	--	--	--	--
		Bull trout	620	0	1	--	--	--	--	--
	3-2	Cutthroat	70-220	0	32	--	--	--	--	--
	3-3	Cutthroat	74-200	0	31	--	--	--	--	--

Appendix G. Continued.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm			Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
					Pass 1	Pass 2	Pass 3			
Rock Cr.	1-1	Cutthroat	30-121	1	6	--	--	--	--	--
	1-2	Cutthroat	94-164	0	10	--	--	--	--	--
		Brook tr	103-154	0	3	--	--	--	--	--
Lime Cr.	1-1	No trout captured								
	1-2	Cutthroat	135-184	0	2	1	--	3	3-4	2.4
	1-3	Cutthroat	85-165	0	5	--	--	--	--	--
	2-1	Cutthroat	105-140	0	5	--	--	--	--	--
	2-2	Cutthroat	118-150	0	4	--	--	--	--	--
	2-3	Cutthroat	86-175	0	7	--	--	--	--	--
	3-1	Cutthroat	80-165	0	10	--	--	--	--	--
	3-2	Cutthroat	80-195	0	9	--	--	--	--	--
	3-3	Cutthroat	73-196	0	7	--	--	--	--	--
Malcom Cr.	1-1	Cutthroat	48-219	1	4	4	2	12	10-21	4.6
		Bull trout	90-130	0	4	5	2	14	11-26	5.4
Trapper Cr.	1-1	Bull trout	106-125	0	2	--	--	--	--	--
	1-2	Cutthroat	183	0	1	--	--	--	--	--
		Bull trout	104	0	1	--	--	--	--	--
		Brook tr	71	0	1	--	--	--	--	--
	1-3	Cutthroat	108-162	0	3	--	--	--	--	--
		Bull trout	106-222	0	4	--	--	--	--	--

Appendix G. Continued.

Stream	Site #	Trout species captured	Length range (mm)	Number of fry captured	Number of trout > 60 mm Pass 1	Pass 2	Pass 3	Population estimate	Confidence interval (95%)	Density (trout/100 m^2)
	1-4	Cutthroat	34-234	28	21	11	--	40	32-58	3.3
		Bull trout	93-119	0	17	9	--	32	26-47	2.7
		Brook tr	220	0	1	0	--	1	1-2	0.08
	1-5	Cutthroat	46-201	2	8	--	--	--	--	--
		Bull trout	135	0	1	--	--	--	--	--
	1-6	Cutthroat	87-212	0	14	--	--	--	--	--
	1-7	Cutthroat	50-189	1	6	--	--	--	--	--
	1-8	Cutthroat	32-204	7	8	--	--	--	--	--
		Bull trout	113-145	0	2	--	--	--	--	--
		Brook tr	170	0	1	--	--	--	--	--
	1-9	Cutthroat	45-182	6	37	13	--	55	50-64	11.6
East Fork Trapper Cr.	1-1	Cutthroat	72-201	0	20	10	--	36	30-50	17.6
	1-2	Cutthroat	44-193	4	14	--	--	--	--	--
		Bull trout	210	0	1	--	--	--	--	--
Caribou Cr.	3-1	Brook tr	91	0	1	--	--	--	--	--
	3-2	Brook tr	103	0	1	--	--	--	--	--
	3-3	No trout were captured								

Appendix H. Length frequency histograms of salmonids captured by electrofishing in selected drainages in north Idaho, 1998.

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Appendix H. Continued.

Appendix H. Continued.

Appendix H. Continued.

Appendix H. Continued.

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Appendix H. Continued.

1998 ANNUAL PERFORMANCE REPORT

State of:	Idaho	Program:	Fisheries Management F-71-R-23
Project II:	Technical Guidance	Subproject:	I-A Panhandle Region
Contract Period:	July 1, 1998 to June 30, 1999		

ABSTRACT

Panhandle Region fisheries management personnel provided private individuals, organizations, public schools, and state and federal agencies with technical review and advice on various projects and activities that affect the fishery resources in northern Idaho. Technical guidance also included numerous angler informational meetings, presentations, and letters; continuation of the Panhandle Region portion of the 1-800 ASK-FISH program; and fishing clinics.

Author:

Ned Horner
Regional Fishery Manager

OBJECTIVES

1. To furnish technical assistance, advice and comments to other agencies, organizations, or individuals regarding projects that affect fishery resources in northern Idaho.

2. To promote the understanding of fish biology and fish habitat needs and the ethical use of the fishery resource through individual contact, public school curriculum, club meetings, public presentations, informational brochures and fishing clinics.

METHODS

Regional fisheries management personnel provided both written and oral technical guidance.

RESULTS AND DISCUSSION

The technical guidance provided by Panhandle Region fish management personnel focused on activities that directly affected fishery resources or resource users in north Idaho. Numerous presentations and programs were made to civic and sportsmen's groups throughout the year. Letters were sent to numerous individuals and organizations in response to specific questions about the fisheries in northern Idaho.

Fishing Clinics

Regional fishery management personnel coordinated six Free Fishing Day fishing clinics in the Panhandle Region. Department-sponsored clinics were held in Bonners Ferry at the Lions Club Snow Creek Pond, Coeur d'Alene at Ponderosa Golf Course, near St. Maries at Anderson Ranch Pond, at Round Lake State Park near Sandpoint, and at the Clark Fork and Mullan State Fish Hatcheries. We also provided fish and guidance for a clinic at Priest Lake sponsored by the U.S. Forest Service (USFS). The clinics were geared toward teaching young anglers how to fish (casting, baiting hooks, etc.), fish identification, the reasons for regulations, fishing ethics and how to clean fish. The emphasis was on education and not competition. Regional personnel, people from other state and federal agencies, and sportsmen's groups helped in making the clinics a big success.

1-800-ASK-FISH

Regional fishery management personnel provided information on northern Idaho fishing opportunities for the 1-800-ASK-FISH and Idaho Fish and Game Internet Web Page angler information program. Several tackle shops, local fishing experts and Conservation Officers were consulted to provide additional information on fishing activities.

Hatchery Management

Numerous discussions were held with hatchery and Fisheries Bureau personnel and concerned sportsmen to discuss potential cuts in hatchery production and the possibility of hatchery closures due to budget cuts. The Regional Fisheries Manager provided input on how hatchery fish were being utilized in the Panhandle Region, where cuts could be made with the least amount of impact, and other fish management issues to be considered if certain hatcheries were closed.

Catch-Out Ponds

The Fisheries Manager provided guidance on the construction of Post Falls Park Pond and participated in the USFS NEPA process for four catch-out ponds along the Coeur d'Alene River. He also coordinated discussions between the Fisheries Bureau, Hecla Mining Company, Louisiana Pacific Lumber Company, and Silver Valley Natural Resource Trustees to complete construction of the Day Rock Pond.

Coeur d'Alene Lake Co-management Issues

The Coeur d'Alene Indian Tribe was awarded ownership of the southern third of Coeur d'Alene Lake by the federal district court on July 28,1998. Several discussions were held with the Tribe to discuss boundary issues, licensing issues, state and Tribal fisheries management and research programs, commercial fishery issues, and current and future hatchery supported programs. The Fisheries Manager responded to numerous calls from the public concerned about potential changes to existing fisheries.

Endangered Fish Species Issues

The Regional Fishery Manager provided information on the abundance and status of bull trout and westslope cutthroat trout *Oncorhynchus clarki* populations in Panhandle Region waters. This information was furnished to numerous individuals, organizations and personnel from state and federal agencies working on issues related to bull trout *Salvelinus confluentus* listing and the petition to list westslope cutthroat trout. The Fisheries Manager participated in a legislative hearing on the Department's role in bull trout recovery efforts in Idaho. Papers on the impact of northern pike *Esox lucius* on adfluvial westslope cutthroat trout in Coeur d'Alene Lake and bull trout restoration efforts in Upper Priest Lake by selective removal of lake trout *S. namaycush* were presented by the Fisheries Manager at the "Management Implications of Co-occurring Native and Introduced Fishers" workshop in Portland, Oregon. The Regional Fisheries Manager coordinated with the Kootenai River sturgeon/burbot/trout research team, Kootenai Tribe, U. S. Fish and Wildlife Service (USFWS), British Columbia Ministry on Environment and the Fisheries Bureau to review and comment on issues related to white sturgeon *Acipenser transmontanus* flow requests, conservation culture, ecosystem (nutrient) issues, and transboundary management programs. Additional discussions were held with the research staff, U.S. Army Corps of Engineers (USACE), Bonneville Power Administration (BPA), USFWS, Kootenai Tribe of Idaho, and British Columbia Ministry of Environment on the depressed status of Kootenai River burbot

Lota lota and possible changes in water management in the Kootenai River system to avoid another listing.

Pend Oreille Lake Water Management

Fishery research personnel were responsible for completing all field activities, while the Fisheries Manager kept the public informed and involved in efforts to change lake level management on Lake Pend Oreille. Several sportsmen meetings were attended, articles were written and interviews were given to newspapers. The Fisheries Manager briefed the Idaho Congressional staff on biological and social issues related to changes in lake level management and set up a public hearing for the Northwest Power Planning Council (NWPPC) to gauge public support for changes to benefit kokanee *Oncorhynchus nerka kennerlyi*. Flooding of the Cusick Valley downstream on the Pend Oreille River in Washington emerged as a potential negative impact of higher winter levels in Lake Pend Oreille. The Fisheries Manager visited the Cusick Valley and spoke with farmers affected by flooding, and discussed the river flow and stage data with water managers at the Corps of Engineers. The Fisheries Manager also developed a deep-water kokanee spawning bed construction proposal as potential mitigation if efforts at changing lake levels are not successful.

Eurasian Milfoil

Eurasian milfoil became established in Hayden Lake, Spirit Lake and the Pend Oreille River above Albeni Falls Dam during the summer of 1998. Eurasian milfoil is a common noxious aquatic macrophyte in many Washington lakes, but it had never been found in Idaho. Concerns were raised about how higher winter pool levels in Lake Pend Oreille could allow Eurasian milfoil to establish above Albeni Falls Dam. However, aquatic macrophyte experts from the University of Idaho attributed milfoil establishment to the right kind of limnological conditions made possible by the hottest July and August on record. Milfoil was rooted in deeper water than what maximum drawdown in Lake Pend Oreille would effect. The fisheries management staff assisted on the water surveys to locate milfoil beds and participated in discussions with Corps of Engineers, County weed control experts, and State water quality personnel regarding control options with selective herbicides.

Box Canyon Dam Relicensing

The Regional Fishery Manager reviewed and commented on fisheries related issues associated with the relicensing of the Box Canyon Dam operated by the Pend Oreille Utility District (PUD) of Newport, Washington. The PUD was a major opponent of higher winter pool levels in Lake Pend Oreille, saying the shift in the timing of water coming down the Pend Oreille River caused a loss of revenue. The Regional Environmental Staff Biologist attended most relicensing meetings and coordinated comments.

Miscellaneous

Coordination meetings were held with hatchery, research, enforcement and Fisheries Bureau personnel to insure management goals were achieved. Private pond permits, transport permits, requests for grass carp *Ctenopharyngodon idella* importation and fish tournament applications were reviewed and forwarded. Requests for commercial guiding activities were reviewed and commented on. Anglers were kept informed of regional fishing opportunities and management programs at club meetings, monthly sportsmen breakfasts, through informational articles written for Panhandle Region newspapers, and numerous interviews with television, newspaper and radio reporters. The Regional Fisheries Management staff presented several programs to Panhandle Region schools on cutthroat trout and participated in other Water Awareness Week activities.

1998 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-23

Project: III - Habitat Management

Subproject: I-A - Panhandle Region

Contract Period: July 1, 1998 to June 30, 1999

ABSTRACT

There were no habitat management related activities in the Panhandle Region during this contract period.

Author:

Ned Horner
Regional Fisheries Manager

1998 ANNUAL PERFORMANCE REPORT

State of: <u>Idaho</u> Program: <u>Fisheries Management F-71-R-23</u>

Project: <u>IV - Population Management</u> Subproject: <u>I-A -Panhandle Region</u>

Contract Period: <u>July 1, 1998 to June 30, 1999</u>

ABSTRACT

Short-set gill nets were used in Upper Priest Lake from June through November to capture and remove 912 lake trout *Salvelinus namaycush*; approximately half of the initial Upper Priest Lake population. Movement of tagged fish and increasing catch rates in October and November indicated fish from Priest Lake were replenishing the population. Three bull trout *S. confluentus* were incidentally killed during the study. A multiple census population estimate indicated the population of adult bull trout in Upper Priest Lake at the time of the study was approximately 93 fish (95% confidence interval of 43-209 fish).

Five streams in the Upper Priest River drainage were identified with sympatric populations of brook trout *S. fontinalis* and bull trout. Over 90% of the brook trout were removed in August and early September from two streams, but only half from the third stream. Removal success was related to the extent of woody debris and riparian cover. Several fish believed to be brook trout x bull trout hybrids were collected.

Bonner Lake was renovated with rotenone at a rate of approximately 1.1 mg/L on October 7, 1998, but the color and residual sludge of the rotenone caused us to question the integrity of the mixture. An electrofishing survey on October 14 indicated that we did not get a complete kill. In 45 minutes of electrofishing the entire shoreline, 17 pumpkinseeds *Lepomis gibbosus* were collected and six more were seen, for a catch rate of two minutes per fish. The pumpkinseeds ranged in size from 65 to 175 mm.

Panhandle Region lowland lakes and rivers were stocked with 141,452 put-and-take rainbow trout *Oncorhynchus mykiss*. A total of 318,085 put-grow-and-take rainbow were stocked. Cutthroat trout *O. clarki* stocking included 43,800 surplus broodstock, 347,622 put-grow-and-take and 451,281 surplus fry. The cutthroat trout net pen program for Pend Oreille Lake was discontinued in 1998. Other trout species stocked included 7,014 brook trout fingerlings and 2.48 million kokanee *O. nerka kennerlyi* fry for Pend Oreille Lake. No lowland lakes received kokanee in 1998. Coeur d'Alene Lake was stocked with 52,300 fall chinook salmon *O. tschawyscha* fingerlings from the Priest Rapids Hatchery in Washington. No tiger muskie *Esox lucius x E. masquinongy* or channel catfish *Ictalurus furcatus* were stocked in 1998.

Hatchery personnel and volunteers stocked 25 mountain lakes in the Panhandle Region in 1998. Most lakes were stocked at a density of around 620 fish/ha. Species stocked included westslope cutthroat trout and domestic Kamloops rainbow trout.

Authors: Jim Fredericks
Regional Fishery Biologist

Ned Horner
Regional Fishery Manager

OBJECTIVES

1. Reduce the risk to adfluvial bull trout *Salvelinus confluentus* in Upper Priest Lake by testing the feasibility of removing lake trout *S. namaycush* from the lake and brook trout *S. fontinalis* from tributary streams.

2. Utilize rotenone to restore lowland lakes to productive trout fisheries when undesirable species become too numerous and there is support from the angling public.

3. Stock lowland lakes and sections of rivers to provide productive trout fisheries where wild trout recruitment is inadequate or angler effort is too high to maintain a fishery with wild production alone.

4. Stock low densities of kokanee *Oncorhynchus nerka kennerlyi* fry in select lowland lakes to create a unique fishery for large kokanee.

5. Utilize net pens to rear westslope cutthroat trout *O. clarki lewisi* for release in Pend Oreille Lake.

6. Stock hatchery reared channel catfish *Ictalurus furcatus* and tiger muskies *Esox lucius x E. masquinongy* to provide unique fisheries.

7. Provide diverse angling opportunities in mountain lakes of the Panhandle Region by maintaining a stocking program with different species of salmonids.

INTRODUCTION

Upper Priest Lake Drainage

Upper Priest Lake is a 567 ha natural lake located in northern Idaho (Figure 1). The lake has a mean depth of .13 m and a maximum depth of 32 m. Upper Priest Lake is connected to Priest Lake by a 3 km low gradient river channel known as the Thorofare. Due to the construction of a small dam at the outlet of Priest Lake, both lakes are at the same elevation (743 m).

Both lakes historically supported healthy populations of bull trout (Bjornn 1957). The Priest Lake population is believed to be functionally nonexistent, and the Upper Priest Lake population is considered depressed and at risk. Lake trout were originally introduced into Priest Lake in 1925 (Bjornn 1957). There are no records of lake trout being introduced into Upper Priest Lake, and they are thought to have emigrated from Priest Lake through the Thorofare. Lake trout were absent from the lake in 1956 when an extensive fisheries survey was conducted on Upper Priest Lake (Bjornn 1957) and were still apparently not established in the lake as late as 1979 (Rieman et al. 1979). Mauser (1986) reported lake trout were occasionally caught in the upper lake in 1985. Detailed angler diaries kept by two avid Upper Priest Lake anglers indicate lake trout were common by 1993, and their catch records show an increasing relative abundance in the following years (unpublished data).

INSERT HARD COPY OF FIGURE 1 HERE

Evidence suggests that lake trout and adfluvial bull trout did not naturally develop sympatric populations (Donald and Alger 1993). Bull trout populations in many lakes outside of the Priest Lake drainage, where lake trout have been introduced, are in decline (Donald and Alger 1993). In Priest Lake, the bull trout population collapsed in a period of only a few years in the early 1980s. From 1956 to 1978, anglers harvested between 1,200 and 2,300 bull trout annually (Mauser and Ellis 1985). In 1983, total catch and harvest were estimated at 159 and 92 fish, respectively, and by 1986, no bull trout were reportedly caught during an April-November creel survey (Mauser et al. 1988). Concurrent with the declining bull trout population, the lake trout population increased rapidly. Annual lake trout harvest was estimated to be less than 300 fish from 1956 to 1970. In 1978, harvest was estimated at 5,700 fish, and by 1994, harvest was estimated at around 14,000 fish. The increase in lake trout abundance is thought to be largely due to the introduction of mysis shrimp *Mysis relicta* in 1965 and a subsequent increase in survival of juvenile lake trout (Mauser and Ellis 1985). Deteriorating tributary habitat, overharvest, and predation and/or competition with lake trout may all have contributed to the collapse of the bull trout population.

Brook trout are also a threat to the long-term persistence of bull trout. Hybridization has been identified as a problem that could result in the loss of bull trout populations (Leary et al. 1993; Mullan et al. 1992). Brook trout and bull trout utilized similar spawning locations during overlapping times (Balon 1984; Rieman and McIntyre 1993), and both species have similar temperature requirements for incubation (McPhail and Murray 1979). Brook trout competition and predation may also negatively affect bull trout. For example, brook trout are believed to exclude bull trout in some Oregon watersheds (Dambacher et al. 1992; Ratliff 1992) as well as in Clark Fork River tributaries (Pratt and Huston 1993; WWP 1996).

Indications of an expanding lake trout population and the potential threat of lake trout and brook trout to native bull trout prompted the experimental removal projects in 1998. The specific tasks outlined were to: 1) use gill nets and angling equipment to capture and remove as many lake trout as possible; 2) collect stomach samples from all lake trout to quantify predation on native species; and 3) remove brook trout from selected reaches of tributary streams and evaluate the feasibility of large scale brook trout removal.

Bonner Lake

Bonner Lake is a 9.7 ha lake located in northeastern Boundary County (T62N, R3E, S17). The lake has a mean depth of 6.7 m, a maximum depth of 18 m, and a total estimated volume of 656,488 m^3 (Figure 2). Most of the land surrounding the lake is privately owned by a single landowner (Wages). The Idaho Department of Fish and Game (Department) maintains an access area on the west end of the lake consisting of a primitive boat ramp, outhouse and camping site.

Bonner Lake was chemically treated in 1955 to eradicate perch *Perca flavescens*, largemouth bass *Micropterus salmoides,* and pumpkinseed *Lepomis gibbosus* and again in 1970 to eradicate pumpkinseeds. It is unclear whether or not the 1970 treatment failed to kill all of the pumpkinseeds or if they were illegally reintroduced, but a population was reestablished by 1972. Largemouth bass and black crappie *Pomoxis nigromaculatus* were introduced in 1988 by the Department with the assistance of local anglers. A total of 120 bass were stocked from the Coeur d=Alene Lake system and 250 crappie from Perkins Lake.

INSERT HARD COPY OF FIGURE 2 HERE

A 1996 lake survey resulted in collections of four fish species all classified as game fish; largemouth bass, pumpkinseeds, rainbow trout *Onorchynchus mykiss*, and brook trout. Most of the total fish biomass in Bonner Lake was comprised of small bass and pumpkinseed that did not contribute to the fishery. The relatively slow growth rates of largemouth bass in Bonner Lake, combined with high natural mortality and/or illegal harvest, suggested that most bass would not reach a legal length of 300 mm. Overwinter survival of rainbow trout is good, and growth rates are high in comparison to other regional lakes, indicating a good potential for "Quality Trout" management. Based on the 1996 survey, removal of the non-trout species was necessary to maximize the quality trout potential of Bonner Lake.

A series of public meetings indicated Bonners Ferry anglers were evenly split between those in favor and those opposed to Quality Trout management. For the rest of the region, anglers overwhelmingly chose Quality Trout management (106 for quality management, 17 for no change). As a result of the biological survey and the public input, the Idaho Fish and Game Commission approved AQuality Trout≅ regulations on Bonner Lake beginning in 1998. A temporary salvage order, suspending size and bag limits from January through October 1998, was issued to encourage utilization of fish prior to treatment.

Regional Stocking Program

Lowland and mountain lakes in the Panhandle Region are capable of growing trout and salmon, but recruitment from wild fish is lacking or inadequate to provide a fishery without stocking. Kokanee fry, put-grow-and-take (fingerling) rainbow, cutthroat and a few brook and brown trout, and put-and-take (catchable) rainbow are utilized to create salmonid fisheries depending on the productivity of the lake and amount of angling effort it receives. Kokanee fry from the Cabinet Gorge Hatchery were stocked in Pend Oreille Lake to supplement wild production lost to the construction of Albeni Falls and Cabinet Gorge dams. Kokanee fry have been stocked at low densities in five lowland lakes to grow exceptionally large kokanee. Westslope cutthroat fingerlings were reared in net pens and released in Pend Oreille Lake, but the program has been discontinued due to lack of public support

Some rivers have been stocked with put-and-take rainbow trout but only where angler access is good and fishing effort is high. Stocked river sections are signed and advertised in brochures to improve returns, but the statewide guideline of a 40% return to the creel by numbers generally were not being met. Methods to increase returns, such as stocking fewer fish more frequently, stocking larger fish or sterile fish, stocking tributary streams versus the main river were being evaluated. Another alternative is to further reduce hatchery trout stocking in rivers, but this will require better public acceptance of restrictive regulations capable of maintaining wild trout. It may also involve the development of alternative fisheries, like catch out ponds built along rivers.

Stocking channel catfish and tiger muskies in a few Panhandle Region lowland lakes has created new fisheries for warmwater species. These fisheries will depend on continued maintenance stocking because summer temperatures are not adequate for channel catfish to reproduce and tiger muskies are a sterile hybrid.

METHODS

Upper Priest Drainage

Lake Trout Removal

In 1998, a netting crew of two people used gill nets to capture and remove lake trout from June through October. We ceased netting from mid-July through mid-September because of the high surface water temperatures (>20^{o}C) and the associated stress to incidentally captured bull trout. We used experimental, monofilament, sinking gill nets, that were pulled every 45-50 min. We initially used 4-5 small nets per set (45.7 x 1.8 m with six panels ranging from 1.8 to 6.4 cm bar measure mesh). Beginning July 13 we switched to larger nets (91.4 x 2.4 m experimental nets with 3 panels of 2.5, 3.8, and 5.1 cm mesh) but fished only 2-3 nets per set. Because we switched to larger nets in the later sampling weeks, we standardized catch to a unit of sampling effort (fish/hr/100 m^2 gill net). The switch to larger nets in week-6 led to an immediate increase in catch rates, even after standardizing to 100 m^2 of net. Some of this may be the result of the improved efficiency of the larger nets, resulting from fish being less likely to swim around or over these nets. We used the standardized gill net catch to standardize the total weekly catch (fish/h/100 m^2 gill net x 65 net h) and then conducted a depletion population estimate using the total number of fish removed on successive weeks (with Microfish v. 3.0 program).

At each set, we recorded the depth, time, and net location. Gill nets were set throughout the entire lake and were moved based on catch rates at a particular site and the discretion of the netting crew. A concerted effort was made to avoid incidental bull trout captures while maximizing the catch of lake trout. When two to three bull trout were caught in a particular set, we relocated the nets in a different area of the lake. Nets were set during daylight hours only. Captured lake trout were measured, weighed and processed for delivery to an area food bank. Stomach samples were collected from representatives of three size categories, and otoliths were removed from all lake trout during the first few sampling weeks.

We continued monitoring lake trout implanted with coded sonic tags in August 1997. Although we attempted to track fish on a weekly basis, telemetry was on a more intermittent schedule in 1998 than in 1997. As part of the 1997 evaluation, we spaghetti-tagged and released 112 lake trout in Upper Priest Lake (for a population estimate). In 1998, we recorded recaptures of tagged fish collected in the gill nets. We also collected movement information from lower Priest Lake anglers who caught lake trout that had been spaghetti-tagged in Upper Priest Lake. Although we did not use reward-tags in this study, they were clearly numbered and identified as Idaho Fish and Game tags.

Bull Trout Population Assessment

All gill netted bull trout were measured and weighed. Bull trout greater than 320 mm were marked with a visual implant (VI) tag, and all bull trout captured were examined for previously implanted VI tags. We used a multiple recapture method to estimate the bull trout population (<320 mm) in Upper Priest Lake during the 1998 effort. This estimate does not include the number of adult fish in the tributaries at the time of the estimate. We used snorkeling data to approximate the total number of adults in the tributaries during the study. We estimated density of bull trout in each reach of the Upper Priest River and the tributaries and extrapolated to estimate total number of bull trout in habitat not snorkeled.

Brook Trout Removal

In cooperation with the U.S. Forest Service (USFS), Idaho Department of Lands (IDL), and USFWS, we conducted snorkeling and electrofishing surveys of tributaries to the Upper Priest River from July 27-30. The main objective of the surveys was to identify distribution and abundance of brook trout, bull trout, and cutthroat trout in the drainage. Of the 13 streams surveyed, the following five were found to have sympatric populations of bull trout and brook trout: Hughes Fork, Upper Priest River, Rock Creek, Ruby Creek, and Trapper Creek (Figure 3). We found brook trout in one additional stream where no bull trout or cutthroat trout were found (Caribou Creek). Because Hughes Fork and Upper Priest River are too large to effectively remove fish, only three of the five streams, Rock Creek, Ruby Creek, and Trapper Creek, were considered conducive to electrofishing. In August and early September, we used a multiple pass depletion approach to quantify abundance of salmonids and to remove brook trout from Rock, Ruby, and Trapper creeks.

Bonner Lake

Bonner Lake was chemically treated with rotenone on October 7, 1998. The type of rotenone used was CHEM-SECT BRAND, CHEM FISH SPECIAL O. F., EPA Register Number 1439-156, with the following chemical composition:

Active Ingredients.................26%
Rotenone.................................5%
Other Cube Extracts...............10%
Methylated Napthalene...........11%
Inert Ingredients......................74%
Total......................................100%

The CHEM FISH rotenone has been stored outside the Clearwater regional office in Lewiston since it was purchased more than a decade ago. To evaluate the integrity of the rotenone and determine application rate, we conducted bioassays on October 2, 1998 from one of the barrels. Results were as follows:

Assay Rate	Time to Loss of Equilibrium (minutes)
0.02	no loss of equilibrium after 2 h (2 PS, 1 LMB)
0.04	140 mm PS - 51 min; 160 mm PS - 77 min; 190 mm LMB - no loss at 2 h, 10 min
0.08	155 mm PS - 60 min; 127 mm PS 73 min
1.00	132 mm LMB - 20 min; 146 mm LMB - 30 min; 128 mm LMB 30 min; 95 mm LMB - 30 min; 225 mm LMB - 36 min

Based on the bioassays, we decided to treat the lake at a rate of 1.0 ppm. We determined the volume of Bonner Lake to be 656,488 m^3. At 1.0 mg/L, we anticipated using 674 L of the CHEM FISH rotenone.

The lake was divided into the following six sections: 1) Deep Water North, 2) Deep Water South, 3) Shallow Water North, 4) Shallow Water South, 5) Shoreline North, 6) Shoreline South. Water volumes and appropriate treatment dosages were estimated for each section. A temperature/dissolved oxygen profile on October 1 indicated the lake was still strongly stratified and that the hypolimnion (7-18 m) contained very low levels of oxygen.

INSERT HARD COPY OF Figure 3 HERE

We used two boats to apply the solution. One boat was equipped with a gas-powered centrifugal pump and 12 m of hose. This boat was operated by two people and was used to apply rotenone to the deep water and to spray the shoreline. The centrifugal pump was calibrated to draw 3.8 L of treatment solution per minute of operation, thereby facilitating appropriate chemical application. The second boat, operated by one person, was equipped with an outboard motor venturi pump mounted on the lower unit and was responsible for applying rotenone to the shallow water areas. One person applied a diluted solution containing one liter of active rotenone to the inlet stream. Two other people assisted with rotenone transfer and clean-up on shore. Prior to application, rotenone barrels were rolled on the ground for several minutes to mix ingredients.

Prior to application, we collected five Asentry fish≅ (three pumpkinseeds and two bass) that were transported to a site in the outlet stream (Sand Creek) approximately 3 km downstream from Bonner Lake. The fish were placed in a live box for observation over the next 24 h.

Regional Stocking Program

Hatchery personnel stocked put-and-take rainbow trout into lowland lakes and drove to mountain lakes throughout the Panhandle Region and sections of river in the Coeur d=Alene, St. Joe, and Moyie river drainages. Put-grow-and-take rainbow and cutthroat were utilized in larger lowland lakes or where a cutthroat fishery is desired. The net pen rearing program for cutthroat trout in Pend Oreille Lake was discontinued in 1997 due to lack of public support. Brook trout were stocked in Bloom Lake, Mirror Lake, and Perkins Lake and brown trout were stocked in Hoodoo Creek to provide specialty fisheries. Fall chinook salmon *O. tschawyscha* were stocked in Coeur d=Alene Lake to supplement wild production. Kokanee fry from the Cabinet Gorge Hatchery were stocked in the Clark Fork River and Sullivan Springs (tributary to Granite Creek on the east side of Pend Oreille Lake) to supplement this regionally important kokanee fishery. Kokanee fry from other sources are generally used to support the lowland lake kokanee program. Mountain lakes were stocked with salmonid fry according to the odd year schedule of the Panhandle Region mountain lakes stocking schedule. Channel catfish and tiger muskie were not stocked in 1998.

RESULTS

Upper Priest Drainage

Lake Trout Removal

Gillnetting - We removed a total of 912 lake trout from Upper Priest Lake in 1998. Lake trout ranged in size from 150 to 1,000 mm (TL), with a median size of 400 mm (Figure 4). Based on otolith analysis, lake trout age ranged from 2 to 20 years, with a modal age of 4 years (Figure 5). Two thirds of the lake trout were between three and five years of age. Weekly catches ranged from 29 to 163 lake trout, and from zero to 11 bull trout (Table 1).

INSERT HARD COPY OF FIGURE 4 HERE

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Table 1. Number of lake trout and bull trout captured during 1998 gillnetting efforts in Upper Priest Lake, Idaho. Recaptured lake trout were those marked in 1997, and recaptured bull trout were those marked previously in 1998.

Sample week	Dates	Lake trout			Bull trout		
		Capture	Standardized catch rate[a]	Recapture	Capture	Recapture	Blt:Lkt Ratio
1	Jun 8-10	83	1.24	2	0	0	0.0:100
2	Jun 15-17	60	0.98	1	1	0	1.6:100
3	June 22-24	90	1.30	1	3	0	3.3:100
4	Jun 30- Jul 1	35	0.69	0	1	0	2.8:100
5	Jul 7-9	53	0.83	1	3	1	5.7:100
6	Jul 13-15	132	1.13	4	6	1	4.3:100
7	Sep 21-24	163	2.00	0	11	2	6.3:100
8	Sep 28-30	62	0.88	1	10	1	13.8:100
9	Oct 13-15	56	0.80	2	3	0	5.1:100
10	Oct 20-22	42	0.61	1	2	2	4.5:100
11	Oct 28-29	56	1.65	0	4	0	6.7:100
12	Nov 4-5	51	0.94	1	0	0	0.0:100
13	Nov 10-11	29	0.99	0	2	0	6.5:100
Total	Jun 8-Nov 11	912	-	14	46	7	5.0:100

[a] Because of the shift to longer and deeper nets, we standardized catch rate to fish/hour/100 m^2 of gill net.

As perceived in the field, standardized catches indicated that the larger and smaller nets fished with different efficiencies. We therefore conducted separate depletion estimates with catch from the small nets (weeks 1-5). The increased slope of the line in the later weeks depicts the improved efficiency and greater rate of depletion than the small nets (Figure 6). The total estimated population using depletion with the smaller nets was 745 ∀369 (95% CI). The depletion estimate from weeks 6-10 using the larger nets was 538 ∀117 (95% CI). However, this estimate does not include the 321 fish removed during the small net effort. Addition of the 321 fish depleted prior to week 6 raises the estimate for the larger net catch to 859 fish and indicates both types of nets yield similar estimates. Weeks 11-13, however, did not fit well with the depletion trend from weeks 6-10. Catch increased sharply in week 11 (October 28-29) and remained relatively high through week 13 (Table 1). Based on examination of gonads and sonic telemetry, weeks 11-13 seemed to correspond to the spawning period and may represent a period of increased immigration from the lower lake.

Throughout the 1998 effort, we collected 46 bull trout. As with the 1997 netting efforts, we saw a broad overlap in the habitats utilized by bull trout and lake trout. Of 35 nets which caught bull trout, 24 (69%) also contained lake trout. We were able to minimize bull trout mortality by netting only when surface water temperatures were $<17^{o}$C, however, we did have three mortalities during the effort. We observed some evidence of an increase in the ratio of bull trout to lake trout throughout the sampling weeks (Table 1). Initially, we captured less than five bull trout per 100 lake trout, but by September we captured as many as 13 bull trout per 100 lake trout. It is important to note, however, that we intentionally minimized the number of bull trout caught by moving nets when we were in an area with a high ratio of bull trout to lake trout. The bull trout to lake trout ratio probably overestimates the number of lake trout per bull trout, and it is not an accurate measure of the true relative abundance of these two species.

Lake Trout Movement - Nine of the 10 sonic tags implanted into lake trout transmitted signals that we were able to locate (the tenth tag was likely malfunctioning when it was implanted). Of the remaining nine tagged fish, we had no apparent mortalities following surgery. In the period from August 1997 through November 1998, at least two of the nine tagged fish had emigrated from Upper Priest Lake to Priest Lake. One of these fish (#555) was located near West Twin Island in Priest Lake on October 2, 1997 nearly 16 km from where it had last been located in the upper lake, and by November 26 it had returned to Upper Priest Lake. In 1998, the same fish left the upper lake between October 1 and October 19 and was once again located in the lower lake near West Twin Island on November 3 (Figure 7). The other fish (#366) remained in Upper Priest Lake through the 1997 telemetry effort, but in June 1998 it had migrated to Priest Lake near Pinto Point approximately 19 km from where it had last been located in Upper Priest Lake. The fish remained in that area through mid-September, but by November it returned to the north end of Priest Lake near the mouth of the Thorofare. An additional sonic tagged fish disappeared from Upper Priest Lake and was not located. Because of the size of Priest Lake, telemetry is logistically difficult and time consuming. The missing fish could very possibly be in the lower lake despite our inability to locate the signal. The remaining lake trout have moved throughout Upper Priest Lake since being tagged. Most fish exhibited no strong affinity to a particular area but seemed to travel widely throughout the lake. We saw no strong evidence of sonic-tagged fish moving to or congregating around a particular spawning site. However, we did not track fish during the night when spawning aggregations may have formed.

Since 1997, anglers have reported catching three spaghetti-tagged fish in Priest Lake that were tagged in Upper Priest Lake. Although three of 112 fish may not seem to be a meaningful percentage, it is important to realize that these are only the fish caught and reported in lower Priest Lake (no reward was indicated on spaghetti tags). Therefore, the three fish reported most likely represent a small percentage of the lake trout that emigrated from Upper Priest Lake and were not caught (or were caught and not reported).

INSERT HARD COPY FIGURE 6.

Figure 6. Standardized weekly catch of lake trout from Upper Priest Lake, Idaho, and depletion trend lines fit to small gill nets (June 8–July 7) and larger gill nets (July 13–October 19). Depletion lines do not include November catches.

INSERT HARD COPY OF Figure 7 HERE

Stomach Content Analysis - We analyzed lake trout stomachs based on three separate cohorts according to length. We quantified importance of various dietary items based on percent blotted weight (Table 2). The smallest cohort was comprised of fish <325 mm. Mysis shrimp *Mysis relicta* were the most important food item of the smallest cohort comprising approximately 90% of the stomach content weight. Ten percent of the diet of the smallest cohort was fish, comprising approximately 90% of the stomach content weight. Ten percent of the diet was fish, half of which were sculpins *Cottus spp.* and half either cyprinids or catostomids. The second cohort was comprised of fish 326-660 mm in length. Although mysis shrimp were still the most dominant food item (62% of content weight), fish were common. Approximately 14% of the diet was mountain whitefish *Prosopium williamsoni*. We found a single bull trout in the stomach of a lake trout within this cohort (4% of the total stomach weight for the cohort). The largest cohort was comprised of fish over 660 mm. Fish were the most important food item of the largest cohort. Only 16% of the stomach content was mysis shrimp. Of the remaining 84%, 24% was mountain whitefish and 43% was unidentified salmonids.

Table 2. Diet composition, based on weight, of three cohorts of lake trout collected from Upper Priest Lake, Idaho from June through November 1998.

					Whitefish		Salmonids		
Cohort (mm)	N	Mysis	Sculpin	Cyprinids/ Catostomids	Pygmy	Mountain	Bull trout	Cutthroat	Unidentified
<325	34	90	5	5	-	-	-	-	-
326-660	145	62	6	4	3	14	4	2	5
>660	27	16	2	15	-	24	-	-	43

Bull Trout Population Assessment

We VI tagged 29 bull trout and subsequently recaptured seven in the 1998 effort. Using a Schnabel multiple census method (Ricker 1975), we estimated a total of 93 adult bull trout in Upper Priest Lake. We approximated 95% confidence intervals using a Poisson distribution and estimated the lower and upper bounds at 43 and 209 fish, respectively. We counted a total of 11 adult bull trout in the Upper Priest River drainage during the August snorkeling survey. All of the fish were within the Upper Priest River mainstem. Based on density of bull trout in the surveyed habitats and the amount of unsnorkeled habitat in the drainage, we estimated a total of approximately 23 adult bull trout in the tributaries in August. Inclusion of these fish increased the estimated population of adult bull trout in the entire system to approximately 116 fish.

Brook Trout Removal

Rock Creek-We electrofished from the Rock Creek mouth upstream about 2 km until the gradient increased and brook trout were no longer captured. We removed a total of 150 brook trout from

Rock Creek in two days of electrofishing. The removal pattern was 94, 37, 19, and the total population was estimated at 150-178 (95% CI). This depletion pattern indicates that we successfully removed over 90% of the brook trout population. Brook trout ranged in size from 44 mm (fry) to 206 mm (estimated to be age-5). All brook trout examined greater than 100 mm were sexually mature. Population estimates of the electrofished reach indicated approximately eight bull trout and 184 cutthroat trout.

Ruby Creek-In August, we removed a total of 853 brook trout in two passes of the lower 3 km of Ruby Creek. However, we had insufficient depletion to believe we had removed the majority of the brook trout. A third and fourth pass were conducted September 9-10. In these two passes, an additional 695 brook trout were removed, bringing the total to 1,548 fish in four separate passes. Unfortunately, even after four passes, the high abundance of brook trout combined with the extensive riparian cover precluded an accurate depletion estimate (total population estimated at 3,303 ∀ 688), and indicated that we did not have efficient removal of brook trout (39-59%). Ruby Creek supports one of the strongest brook trout populations in the Upper Priest drainage, and brook trout were the dominant species in the stream. In the first pass (the most representative estimate of species composition prior to removal), we caught 436 brook trout and 100 cutthroat trout. In subsequent passes we captured two bull trout.

Trapper Creek-We electrofished Trapper Creek from the mouth upstream approximately 1 km. In this reach, we removed four brook trout and captured four probable brook trout x bull trout hybrids. We released the probable hybrids after collecting fin samples for genetic analysis. Thirty-nine juvenile bull trout were also collected. We did not continue electrofishing upstream of this initial reach of Trapper Creek due to the low abundance of brook trout and the high abundance of juvenile bull trout, combined with the possibility of shocking spawning adult bull trout.

Bonner Lake

Application of Chem-Fish rotenone went smoothly. Fish began gilling on the surface soon after treatment of shallow water. In the shallow shoreline areas many fish were observed that appeared unharmed, but within an hour after the shoreline was sprayed, dozens of small pumpkinseeds and largemouth bass were dead and dying around the lake. We observed only one legal bass, saw no crappies, and interestingly no trout.

We experienced some difficulty mixing the contents of the Chem-Fish barrels. Each barrel contained a residual sludge with a black and a light brown granular precipitate of varying amounts. Because of the unknown composition of sludge in the barrels, we opted not to thoroughly rinse the barrels on site. This was somewhat problematic in that it plugged the venturi lines when the barrel was nearly empty, but more importantly it made us question the effectiveness of the rotenone. We also found that rotenone from at least one barrel formed a gray/brown liquid instead of the usual white. This was also cause for our questioning the effectiveness of the rotenone from one of the barrels. Pockets of Ahealthy fish≅ were observed up to three hours after the treatment began. For these reasons, we opted to apply the remaining 102 L and treat at a rate of approximately 1.1 mg/L instead of 1.0 mg/L.

Fish held in Sand Creek 3 km below the lake were all unaffected 24 hours after treatment. As expected, the dilution and oxidation of the rotenone rendered it non-toxic at the monitoring site, and detoxification with $KMNO_4$ was not necessary.

A follow-up electrofishing survey on October 14 indicated that we did not get a complete kill. In 45 minutes of electrofishing the entire shoreline, we collected 17 pumpkinseeds and saw six more, for a catch rate of 2 minutes per fish. The pumpkinseeds ranged in size from 65 to 175 mm. No other species were observed alive. We did observe approximately eight dead trout and one legal sized bass, but saw no crappies.

Salmonid Stocking

In 1998, a total of 183,726 put-and-take rainbow trout were stocked in the Panhandle Region, 141,452 in 31 lowland and drive to mountain lakes and 42,274 in sections of 10 rivers or streams. Hayspur, domestic Kamloops and unspecified stocks of rainbow trout were used for put-and-take stocking.

Fingerling westslope cutthroat trout from the Clark Fork Hatchery were stocked in seven lakes to provide put-grow-and-take fisheries. Surplus fry, fingerlings and broodstock were available in 1998 and were stocked into a variety of waters to supplement planned stocking programs (Table 3).

Table 3. Summary of cutthroat trout stocked in lowland lakes of the Panhandle Region, Idaho, in 1998.

Species stocked	Lake stocked	Number stocked	Comments
Cutthroat trout:			
Fingerling Program	Cocolalla Lake	47,966	
	Fernan Lake	8,910	
	Hauser Lake	39,600	
	Hayden Lake	101,563	
	Mirror Lake	10,387	
	Pend Oreille Lake	70,189	
	Spirit Lake	49,687	
	Total	328,302	
Surplus Fry	Fry Creek (Sagle Slough)	112,948	
	Hayden Creek	136,964	
	Spring Creek	201,369	
	Total	451,281	
Surplus Fingerlings	Kelso Lake	19,320	
	Total	19,320	
Surplus Broodstock	Lake Pend Oreille	39,268	Replaced net pen fish
	Clark Fork River	4,532	Avista research
	Total	43,800	

Fingerling brook trout were stocked in Bloom Lake and Perkins Lake to maintain popular put-grow-and-take fisheries (Table 4). Brown trout were not available in 1998. Due to budget cutbacks, brook trout and brown trout will no longer be stocked after this year.

Table 4. Summary of fingerling rainbow and brook trout, kokanee fry and fall chinook salmon fingerlings stocked in lowland lakes and rivers of the Panhandle Region, northern Idaho, in 1998.

Species stocked	Lake stocked		Number stocked	Comments
Rainbow trout:				
Fingerling program	Hayden Lake		296,055	
Surplus fingerling	Cocolalla Lake		13,120	
	Lower Twin Lake		8,910	
		Total	22,030	
Brook trout:				
Fingerling program	Bloom Lake		1,014	
	Perkins Lake		6,000	
		Total	7,014	
Surplus fingerling	Hauser Lake		9,984	
	Upper Twin Lake		22,506	
		Total	32,490	
Kokanee:				
Pend Oreille Lake	Sullivan Springs		2,483,740	
Fall chinook salmon:	Coeur d’Alene Lake		52,300	Stocked at the Mineral Ridge boat ramp

No lowland lakes were stocked with kokanee fry in 1998 due to shortages, and all fry available went to the Pend Oreille system (Table 4). Fall chinook salmon from the Priest Rapids Hatchery in Washington were used to stock Coeur d’Alene Lake in 1998 due to the weak spawning run in Wolf Lodge Creek. Floods during the winter of 1996 and spring of 1997 caused significant losses of both chinook salmon and kokanee from Coeur d’Alene Lake.

Mountain lakes were stocked with salmonid fry according to the even year schedule of the Panhandle Region mountain lakes stocking schedule. Twenty-one lakes were stocked with cutthroat fry and four with rainbow fry. Stocking was completed by hatchery personnel and volunteers using backpacks, horses and, where accessible, motorized vehicles.

DISCUSSION

Upper Priest Drainage

Lake Trout Removal

The progressive decline in gill net catch rates throughout most of the season, and the concurrent improvement in the lake trout:bull trout ratio, demonstrated that the 1998 gillnetting was successful in removing a significant portion of the lake trout population in Upper Priest Lake. At the same time, we were able to minimize negative impacts to bull trout. Unfortunately, recovery of the spaghetti-tagged fish depicts a less successful effect. The 1997 population of 466-1,913 fish (estimated with mark-recapture) and the 1998 population of 483-1,002 fish (based on removal from weeks 1-10) both indicate that removal of 912 lake trout should have represented a very sizeable reduction in the population. In fact, we should have removed between 48 and 100% of the population and recovered 53 to 112 of the spaghetti-tagged fish. Only 14 had been recovered. Similarly, we have recaptured only three of the 10 sonic-tagged fish. Several possibilities may explain the poor recovery rate of tagged fish. First, the tagged fish may have had a much higher mortality. We do not believe this is the case, however, because of the high survival (90-100%) of sonic tagged fish that were also spaghetti-tagged. Second, the tags may be tearing or falling out. Again, we believe this is unlikely. We have examined lake trout for scars or sores, and we have seen no evidence of tag loss. Furthermore, the two sonic tagged fish that were recovered both had retained the spaghetti tags. We believe the most plausible explanation is movement of lake trout between Upper Priest and Priest lakes. Emigration of tagged fish combined with the immigration of untagged fish could greatly skew the tag recovery rates as well as explain the apparent increase in population from 1997 to 1998.

Movement of sonic and spaghetti tagged lake trout demonstrated that lake trout migration between Upper Priest Lake and Priest Lake was common. Emigration of two to three of the nine sonic tagged fish indicated that a significant portion of the fish marked in Upper Priest Lake in 1997 moved to the lower lake. This was also confirmed by anglers who caught spaghetti-tagged fish in Priest Lake. We consider the documented number of fish traveling between the lakes to be a minimum estimate. Because of the irregularity of telemetry in 1998, additional sonic tagged fish may have traveled between the lakes at times when no monitoring was being conducted. Furthermore, the increase in gill net catch rates observed in late October is possibly a result of immigration related to spawning/post spawning activity.

The effectiveness of a lake trout reduction program in Upper Priest Lake is largely based on the assumption of a relatively closed population. The slow growth and late age-at-maturity of lake trout make them easily over-exploited (Healey 1978) and imply that removal of mature fish could cause meaningful population reduction. Prior to the 1998 effort, we were well aware that recruitment to the population of mature Priest Lake immigrants could easily offset gains made by removal of Upper Priest Lake fish. Unfortunately, the results of the 1998 netting effort and the movements of tagged fish indicate that Upper Priest Lake and Priest Lake now represent a single, open population.

Options for eliminating or minimizing recruitment from the lower lake are limited, complex, and controversial. The most ambitious (and most controversial) alternative would be to attempt collapsing the lake trout population in Priest Lake as well as in Upper Priest Lake. The lake trout fishery in Priest Lake is extremely popular, with lake trout anglers comprising around 85% of the total effort in 1994 (Horner et al. 1997). Aside from social implications, the feasibility of such a project is questionable. Priest Lake is nearly 9,500 ha, or roughly 17 times the size of Upper Priest Lake. Although commercial methods used in the Great Lakes have been proven to be very efficient and capable of severely depressing lake trout populations (Healey 1978), such a project could easily cost several hundred thousand dollars. The second alternative is to utilize a weir or other fish passage barrier in the Thorofare to prevent immigration to Upper Priest Lake. Although this may seem simple, there are many social and biological implications to this alternative as well. Upper Priest Lake is a very popular boating site. Canoeists, kayakers, and hikers have unsuccessfully lobbied to restrict motor boats from Upper Priest Lake in the past. Any structure preventing boat passage may be very unpopular with many recreationists as well as local governing officials. Variable flows, floating debris, and limited access are factors that would influence the effectiveness of a weir. Furthermore, the Thorofare is likely a passage corridor for westslope cutthroat trout, bull trout, mountain whitefish, and other native fish, and the potential for negative impacts of a migration barrier to these populations will need to be considered.

Brook Trout Removal

Effectiveness of multiple-pass electrofishing efforts to reduce brook trout in the tributaries was mixed. We believe the removal efforts in Rock Creek will likely suppress the brook trout population for several years. Because of the young age and small size-at-maturity of brook trout, however, our Ruby Creek efforts will probably not result in any long-term population suppression. Our relative inefficiency in Ruby Creek was a result of woody debris and the dense riparian cover. Even after four passes, we had removed only about half of the brook trout population, and it is unlikely that we could have achieved a 90% or higher removal regardless of the number of passes. Because of the very low abundance of bull trout combined with the fact that the stream flows subsurface for an approximately 0.4 km reach above its mouth, Ruby Creek may be a good candidate for future chemical treatment.

The value of brook trout removal efforts in Trapper Creek is less clear because of potential harmful effects of electrofishing to bull trout. Brook trout were the predominant species in Rock and Ruby creeks, and we believe the benefits of removing several hundred brook trout far outweigh the risks of electrofishing the occasional bull trout. In Trapper Creek, we found around 10 bull trout for each brook trout, and the relative risks to the population are not as clear. Because we only collected four brook trout during the first pass, we decided against conducting a second pass. However, we believe removal of the four brook trout during the single pass was not an unwarranted risk. The apparent occurrence of hybrids demonstrates the potential risk of even a few brook trout to the bull trout population. In this effort, and in previous electrofishing efforts on Trapper Creek, we found most brook trout and suspected hybrids in the lower portion of the creek. Only an occasional brook trout has been caught (and removed) in the upper reaches above the high gradient section, suggesting that the high gradient reach inhibits upstream brook trout migration. The natural impediments to brook trout migration, combined with the possibility that the population is currently low but expanding, suggest eradication efforts are particularly warranted in Trapper Creek (Montana Bull Trout Scientific Group 1996). Although we did not use block nets to partition reaches during the 1998 efforts, they could be used in the future to reduce the number of times bull trout are electrofished.

RECOMMENDATIONS

1. Use short-set gill nets in Upper Priest Lake in 1999 to continue lake trout removal and further evaluate effectiveness of 1998 efforts.

2. Begin a feasibility study of methods for blocking lake trout migration to Upper Priest Lake.

3. Electrofish Ruby, Rock, and Trapper creeks to evaluate effectiveness of 1998 efforts and continue brook trout removal.

4. Confer with USFS explosives experts and fisheries personnel to evaluate the possibility of utilizing explosives on Porcupine Lake to eradicate brook trout.

<u>Bonner Lake</u>

Several possibilities may explain our failure to achieve a 100% fish kill in Bonner Lake. As discussed earlier, some of the Chem-Fish may have been compromised. The rotenone was stored outside and subject to freezing temperatures against the manufacturer's recommendation. The outside storage, combined with the age of the Chem-Fish, may have reduced the effectiveness of the active ingredients. Although the bioassays indicated that 1.0 mg/L was sufficient to quickly kill test fish, we conducted bioassays with Chem-Fish from only one of the barrels. The toxicity of the rotenone may have varied between barrels.

Another possible explanation for the incomplete fish kill is refuges of non-toxic water. The bottom of Bonner Lake is covered by a dense vegetative mat ranging from one half to one meter thick, which is covered by a thin layer of marl. Although we did not find documentation of similar situations in the literature, it seems possible that the vegetative mat may have provided a physical and/or chemical impediment to thorough mixing of the toxicant. Alternatively, the observed difference between inflow and outflow to Bonner Lake suggests there are upwelling springs (totaling 7-10 L/min) which may have provided refuges.

The attempt in 1970 to eradicate pumpkinseeds from Bonner Lake was also unsuccessful. Although they may have been reintroduced rather than survived the treatment, the past failure suggests refuges may prevent a complete kill.

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